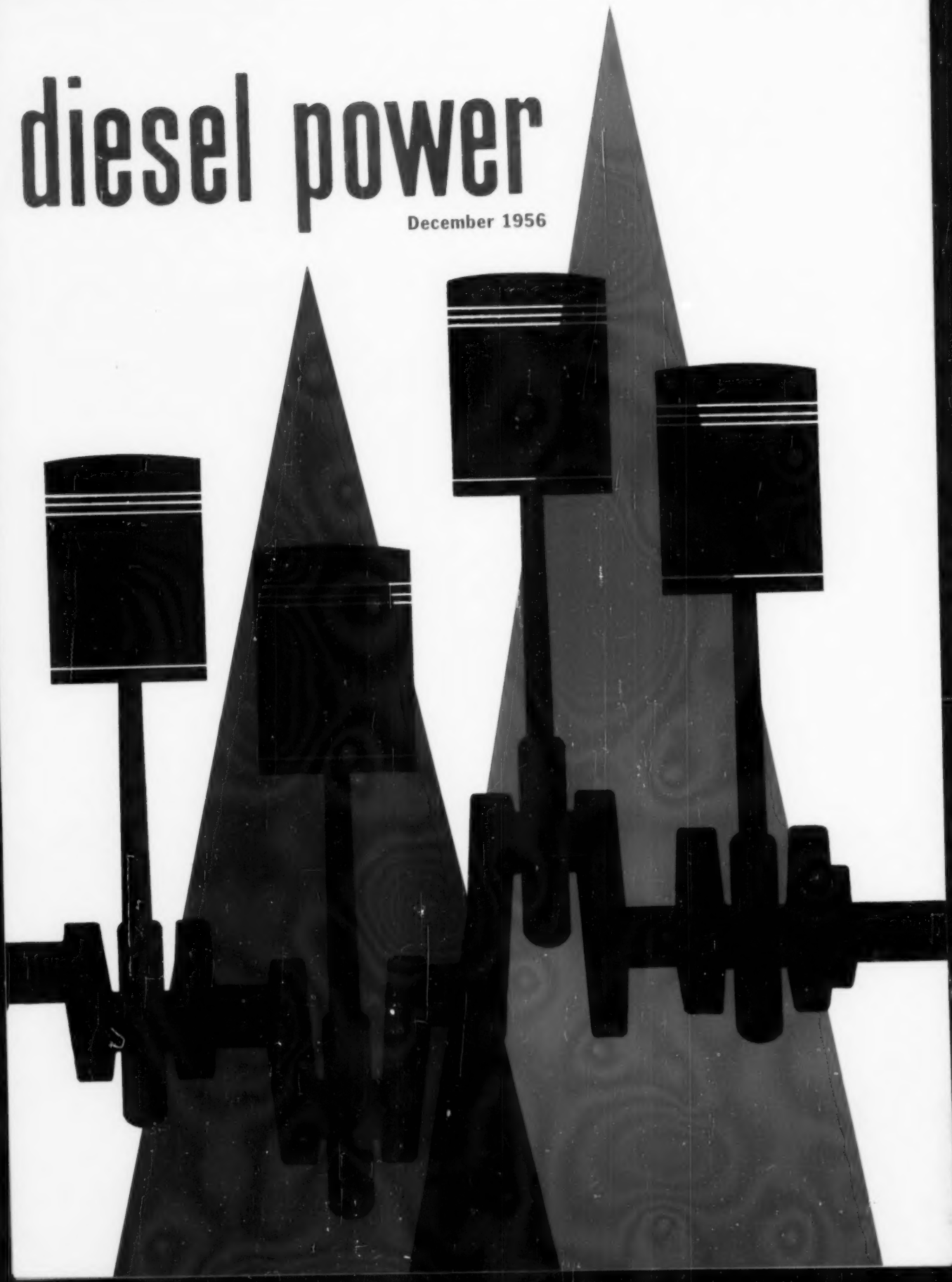
diesel power

December 1956



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THE SUPERINTENDENT of this power plant (name on request) reports:

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There is a complete line of *Texaco Ursa Oils*—all especially refined and processed to make diesel, gas and dual-fuel engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

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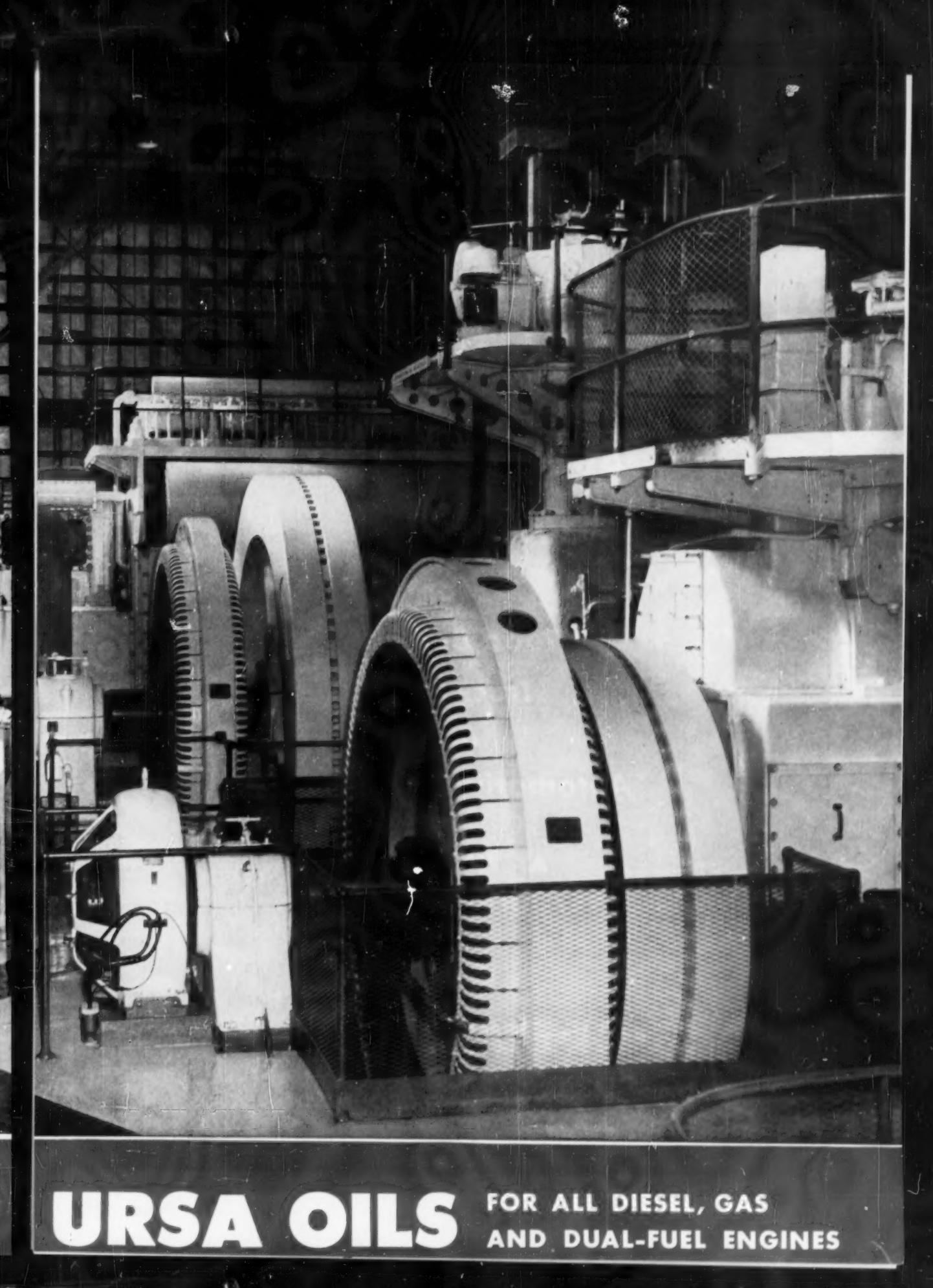

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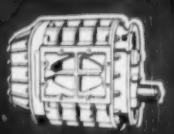

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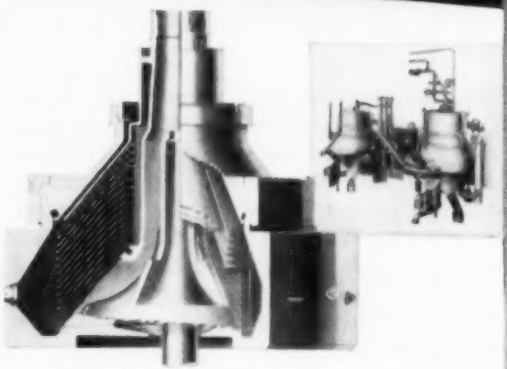

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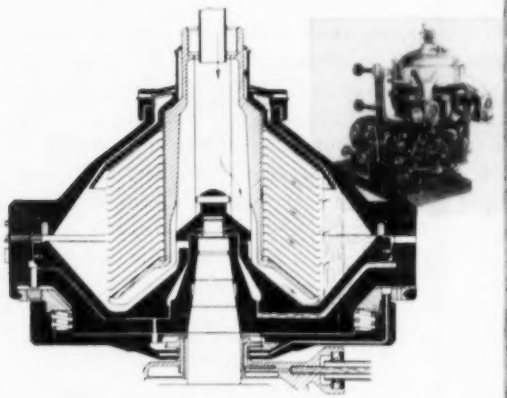
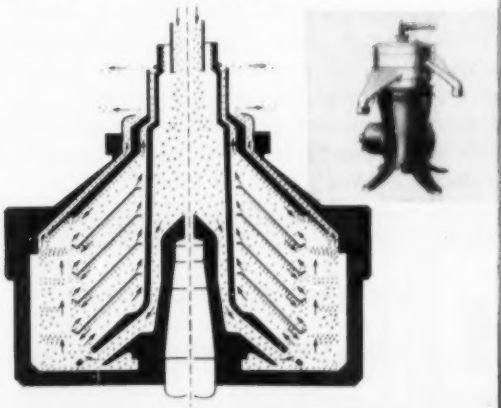


PX 209.00 Self-Cleaning Centrifuge



Model 94 Standard Solid Bowl Purifier

Only De Laval offers you every type of heavy fuel oil centrifuge . . . for *both* small or large size plants—ashore or afloat!

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All three De Laval Heavy Oil Purifiers have demonstrated their efficiency *in service* . . . have proved they do their job so well that the savings are *actual*, not dissipated in added maintenance expense.

Complete details on request . . . without obligation.

RECOMMENDED CAPACITIES—G. P. H.

VIS.	TEMP.	AC-VO	PX 209. F	MODEL 94
500	180° F	1200	600	300
700	180° F	1100	550	275
1700	180° F	660	330	165
2500	180° F	560	280	140
4000	190° F	440	220	110
5000	200° F	300	150	75

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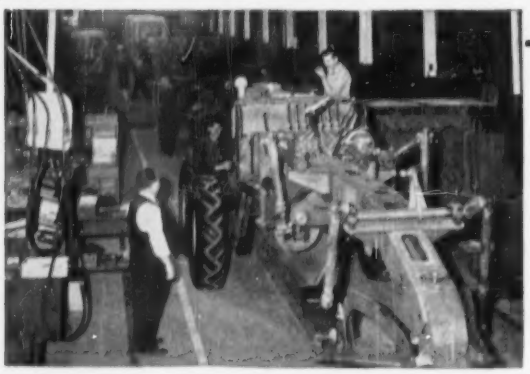
Your problems of engine power analysis, selection, and installation are simplified when you specify International power for your equipment. International's complete and experienced staff of manufacturer sales representatives, and sales and design engineers supply you with engine dimensional drawings, accurate power curves, and complete specifications. They also help you select the International engine best suited to your particular power, torque, and rpm requirements, and adapt International engines for your tough special applications.



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International engineering service can help you cut manufacturing costs, speed up production by showing you the best way to mount International engines in your equipment. Pilot engine models, for your research, production, and testing purposes are also available. In addition, you stand a better chance to sell more of your machines when you offer the buyer International engines as standard or optional equipment. Yes, International engines in the equipment you sell, helps you sell it faster...and helps keep it sold longer.

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When you specify International engines you gain the benefits of skill and experience of engine design and manufacture since 1903. In fact, more four-cycle, heavy-duty International diesel engines have been sold since production began in 1933 than any other make. Reasons for this terrific popularity are such inbuilt features as special delivery pressure lubrication through rifle-drilled passages, replaceable cylinder sleeves, and many others.

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diesel power

Established in 1923 Vol. 34, No. 12 December, 1956

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For coastal shipping and trans-continental service for single, double and 4 engine propulsion units.

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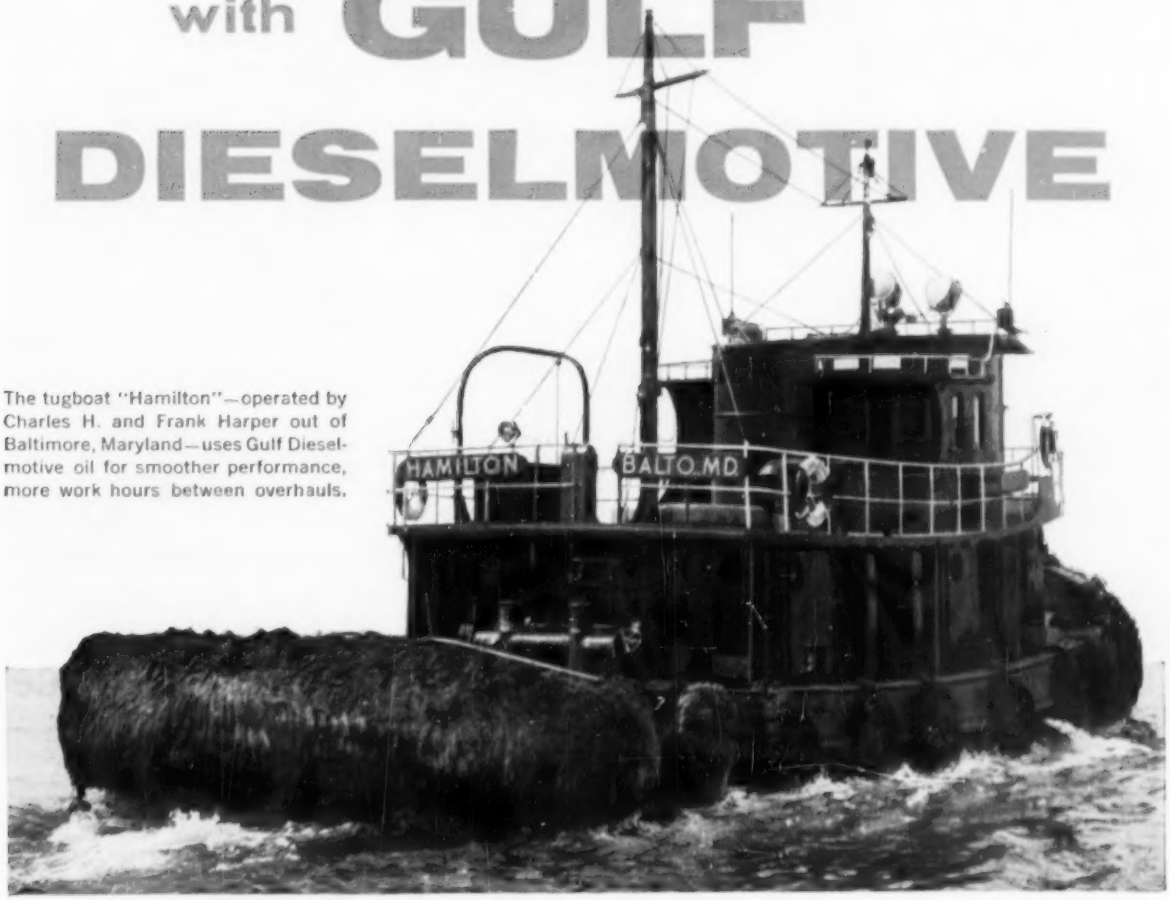

The tugboat "Hamilton"—operated by Charles H. and Frank Harper out of Baltimore, Maryland—uses Gulf Dieselmotive oil for smoother performance, more work hours between overhauls.

Up and down the coast, on the inland waterways —diesel boats like the "Hamilton" are getting thousands of extra trouble-free hours with Gulf Dieselmotive. It can keep your engines running just as smoothly and cut your operating costs . . . because Gulf Dieselmotive gives extra protection at three important points.

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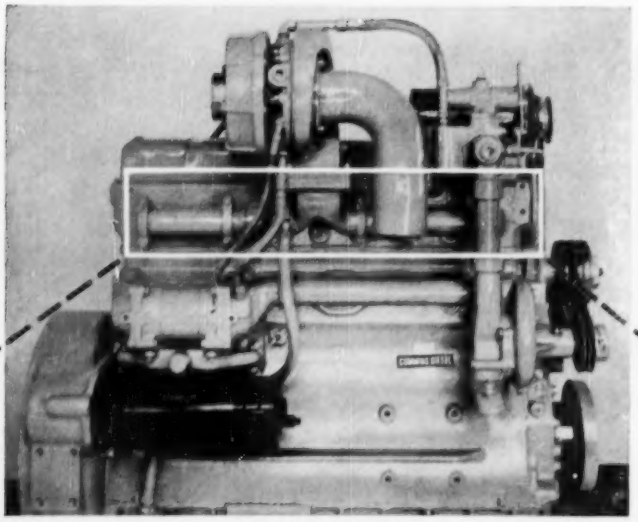
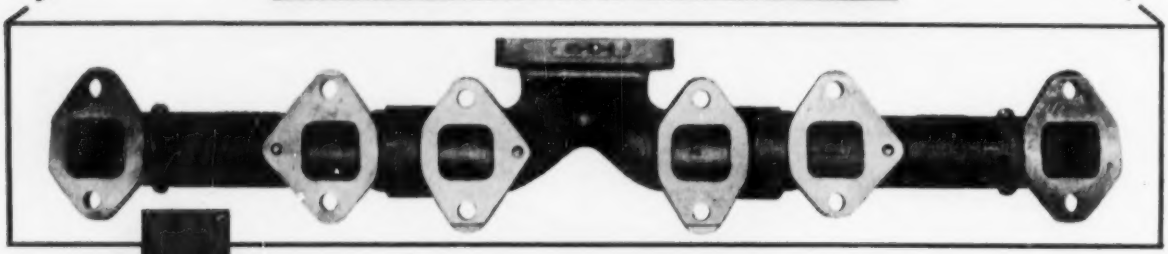


Heat resistance assures prolonged life for the Ni-Resist exhaust manifold on this Cummins automotive JT-6 TURBODIESEL* engine. Ni-Resist exhaust manifolds are installed as original equipment on all TURBODIESEL supercharged engines produced by Cummins Engine Company, Inc., Columbus, Indiana.



CUMMINS ...standardizes on Ni-Resist exhaust manifolds, cuts maintenance of TURBODIESEL engines

Turbocharging of automotive, marine construction and industrial engines increases horsepower substantially. But it also raises exhaust gas temperatures into the range of 1200°F and above.

Exhaust manifolds commonly become red hot especially during long, tough hauls by heavy-duty automotive units. All too soon the heat deteriorates manifolds made of conventional materials.

After testing numerous metals and alloys, Cummins Engine Company, Inc., standardized on Ni-Resist* nickel corrosion-resisting iron for exhaust manifolds of *all* their turbocharged engines. Because this versatile cast material withstands these high temperatures . . . *over long periods.*

Minimizes "between-overhaul" Maintenance

Ordinarily, automotive diesels are overhauled about every 200,000 miles. But burn-outs, cracking and growth of manifolds made from usual materials necessitate replacement during the period between regular overhauls. By contrast, the long life of Ni-Resist manifolds naturally minimizes such extra work and expense.

Ni-Resist manifolds resist oxidation and scaling. If scale does form, it's tight and adherent. This prevents "flake-off" and thus protects turbocharger blades. Moreover Ni-Resist austenitic cast iron resists warping, growth and cracking. Cummins specifies Type 2b Ni-Resist for expansivity matching that of adjacent parts. For the same reason, some manufacturers use Type 3 in similar assemblies.

Resistant to wear as well as heat and corrosion, Ni-Resist manifolds as well as other engine parts can save you money. For further information, fill in this coupon and mail it now.

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Gentlemen: We'd like more information on Ni-Resist to withstand heat ☐ corrosion ☐ wear ☐

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☐ Please send booklet, "Diesel Dan's Manual."

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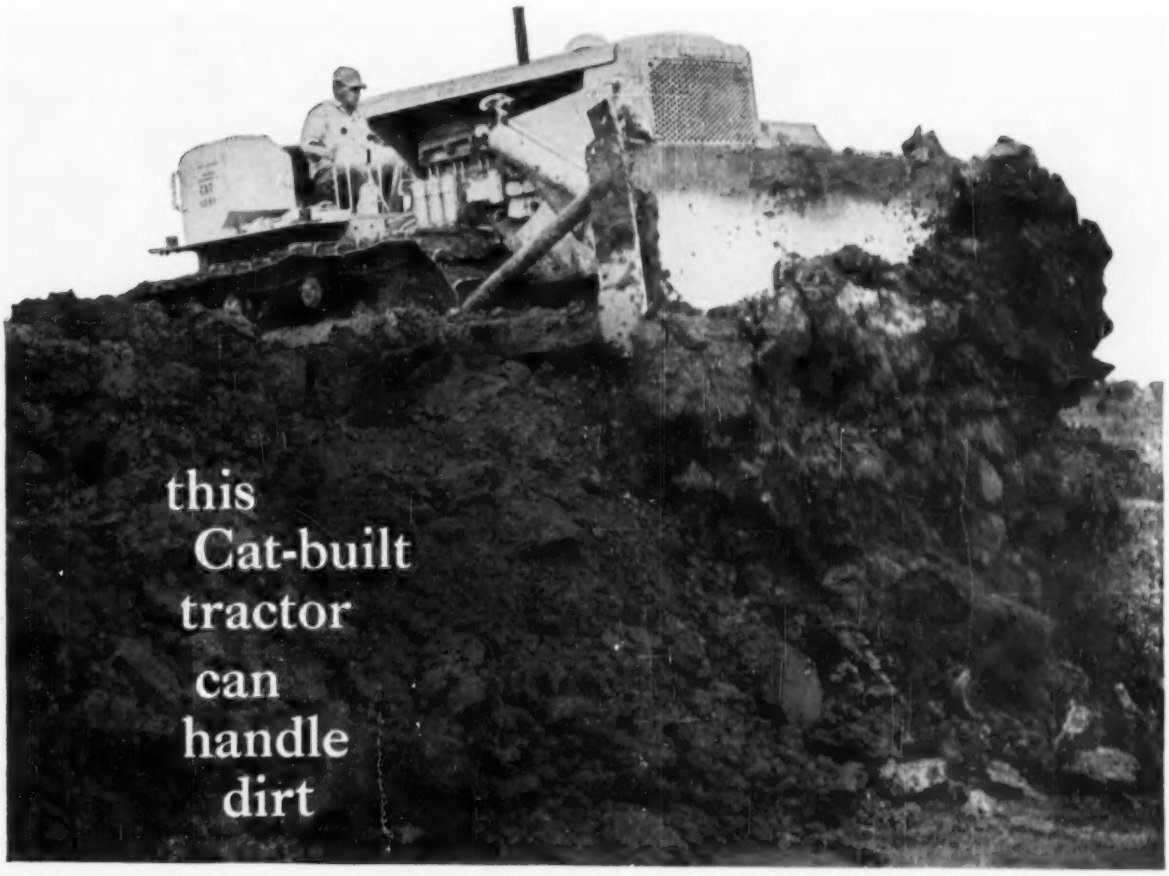

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Your Caterpillar dealer well knows the damage that dirt-laden oil can do to your tractor. Precision parts can be ruined in a matter of hours if unfiltered oil gets into the engine. That's why he always insists on giving you Caterpillar replacement filters. Built to meet the specific requirements of your engine by Purolator, they can handle all the volume your Cat-built tractor requires . . . they never let oil "by-pass" the filter . . . never let harmful abrasives enter the engine.

It's common sense to do as your Caterpillar dealer does . . . insist on Caterpillar filter refills. The life of your engine is at stake.

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A major implement company switched to solid aluminum for main connecting rod and thrust bearings in tractors. Result: a *drastic* reduction in bearing failures . . . *much* longer bearing life.

In hundreds of different kinds of applications solid aluminum bearings are outperforming bronze and babbitt because aluminum has an *unmatched combination of advantages.*

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TURBINE AND DIESEL LUBRICANT GUIDE

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Manufactured from the highest quality, solvent refined stocks, these oils have high viscosity index, excellent heat resistance. They are chemically fortified to prevent oxidation, rust, and foaming, permit smoother operation.

PACEMAKER 150-T

Recommended for pressure-circulation systems of direct-connected steam turbines, and for the bearings of turbo-generators where pressure-circulation of the oil is employed.

PACEMAKER 300-T

For use in the lubrication of steam turbines with single reduction gear units. Also for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are not above 200°F.

PACEMAKER 400-T

Recommended for the lubrication of propulsion turbine units on naval and commercial vessels, in pressure-circulation systems.

PACEMAKER 500-T

Suitable for the lubrication of ring-oiled bearings of auxiliary turbines where operating conditions require an oil of heavier body than Pacemaker 300-T. Also recommended for use in separately lubricated turbine gear reduction units.

PACEMAKER 750-T

Recommended for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are in excess of 200°F., and use of a heavier bodied oil is required.

CITIES SERVICE DIESEL OILS

Made in the world's most modern lubricating oil refinery at Lake Charles, Louisiana, Cities Service Diesel Oils are blended from highest quality, high V.I. mineral oils and fortified with specially developed additives. There's a Cities Service Diesel Oil tailored for top performance in every type of diesel operation.

D-C 300 SERIES

These oils are designed to fully conform to Military Specification MIL-L-2104A. Made from the finest base oils, they are strongly fortified against oxidation and corrosion. They have the necessary detergent-dispersant properties to insure superior lubrication performance in high speed Diesel engines operating under heavy duty service.

Recommended for service DG under A.P.I. classification system.

D-C 100 SERIES

These oils are designed to conform to U. S. Army Specification 2-104B (Supplemental List 1). They are also known as Superior Lubricants Series 1 and are intended for more severe service than the D-C 300 Series Oils. Particularly recommended for the lubrication of medium and high-speed Diesel engines using lower quality fuels.

Recommended for service DM under A.P.I. classification system.

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These oils meet the requirements of The Caterpillar Tractor Company for a "Superior Lubricant (Series 3)". They have the highest level of detergent-dispersant action with maximum oxidation and corrosion protection to assure reliable operation of Diesel engines under most severe service conditions or where low quality fuels of very high sulphur content are used.

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PACEMAKER SERIES

The new Pacemaker line of Diesel engine oils is made from the same high quality base oils as are the Pacemaker T Series, and contains similar additives, but in lesser amounts. These oils are adaptable for use in many low and medium speed stationary engines operating under conditions which would not require the use of heavier fortified oils, such as the Pacemaker T Oils.

PACEMAKER T SERIES

These are medium duty, high grade, high V.I. oils fortified against oxidation, rust and foam. Admirably suited for slow and medium speed engines employing the dry sump system of lubrication and operating under conditions where the service is not severe enough to benefit from a full heavy duty oil.

NEPTUNE 9000 SERIES

Designed specifically for lubrication of marine-type Diesel engines, both military and commercial.

Neptune 9000 Series Oils are made from high quality, high V.I. solvent refined stocks and are strongly fortified against oxidation and corrosion. They are specially inhibited against silver alloy bearing corrosion and have the necessary detergent-dispersant properties to give maximum performance under severe operating conditions.

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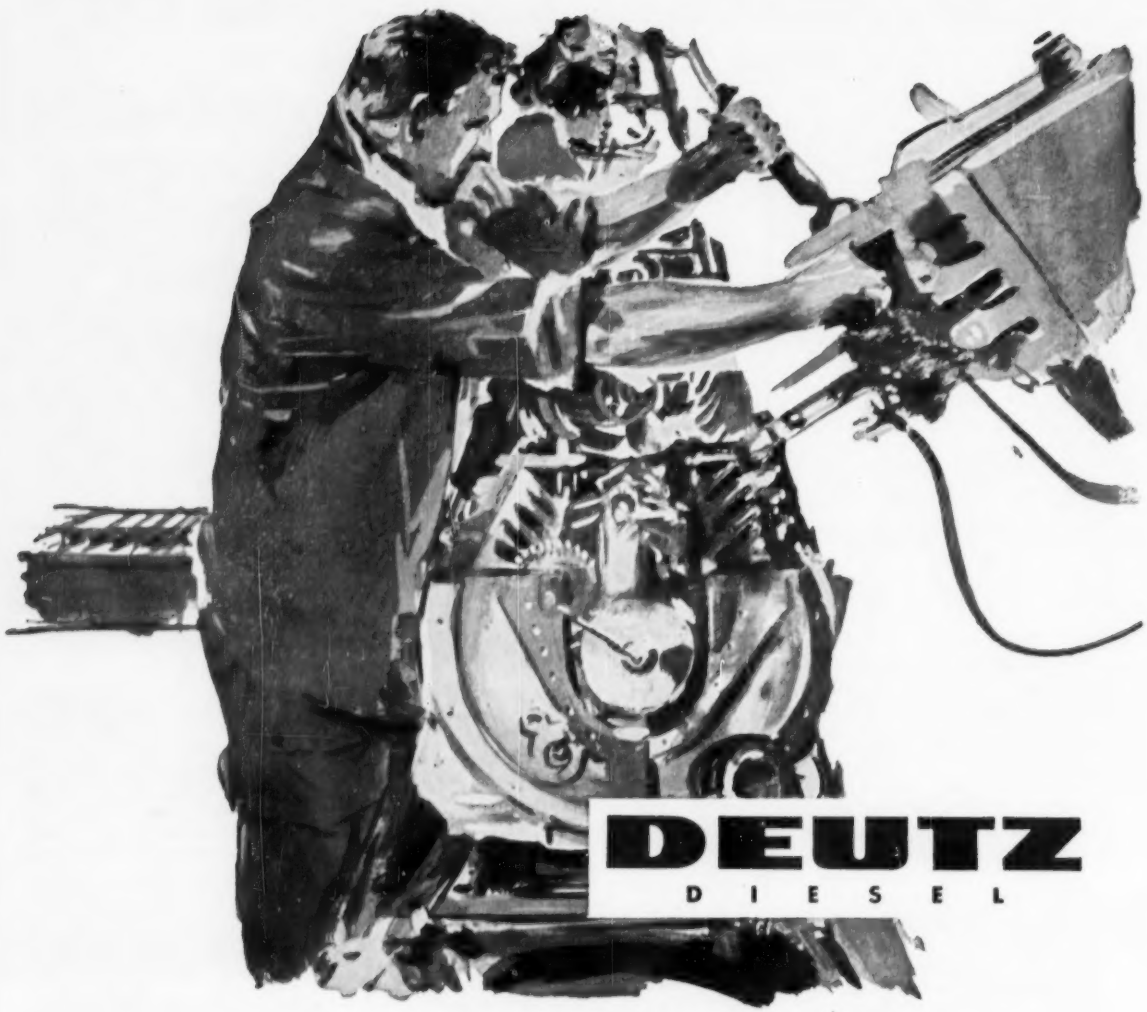
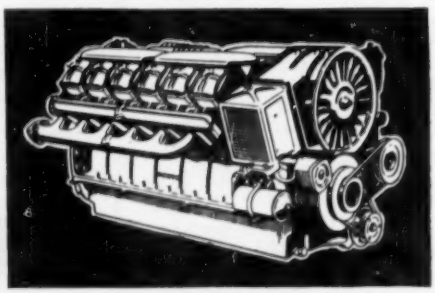
QUALITY PETROLEUM PRODUCTS



air-cooled

began in 1948 to build air-cooled diesel engines in large series. 7 years after, in 1955, the oldest engine manufacturers in the world had built and sold 150.000 air-cooled DEUTZ diesel engines totalling 7.5 Million B.H.P. These equipment engines are used all over the world for every kind of application. DEUTZ builds air-cooled 1 to 12-cylinder diesel engines with an output range from 5 to 250 B.H.P. for road vehicles, rail vehicles, water craft, working machines in all fields of application, generator sets for stationary and mobile electric and power plants.



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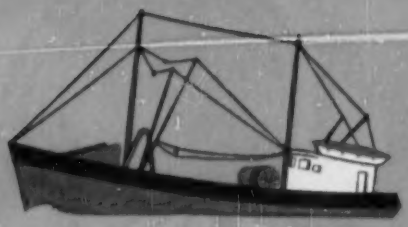
the finest diesels on land or sea use FRAM Filters



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Allis-Chalmers Manufacturing Co.
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Bacharach Industrial Instrument Co.
Buda Div. Allis-Chalmers Mfg. Co.
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Hedges Diesel, Inc.
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The Lincoln Electric Co.
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Minneapolis-Moline Company
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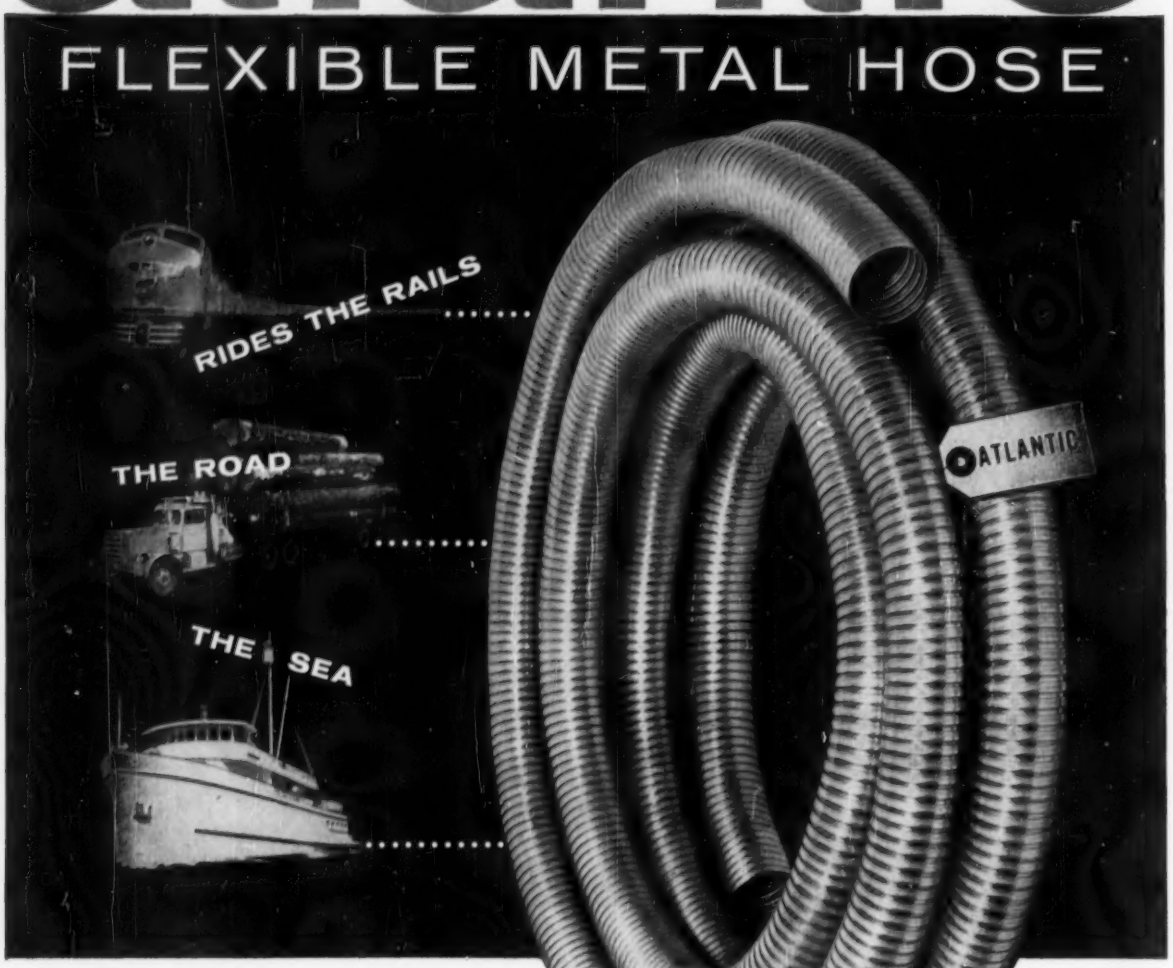
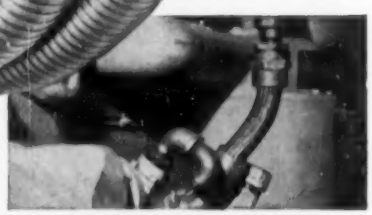


When diesels power trucks hauling 70,000 lb. loads of logs over mountain roads — or locomotives and ships, Atlantic flexible metal hose is usually given the job of guarding those vital diesel life lines—water, fuel, exhaust.

Atlantic flexible metal hose is manufactured to tough specifications.

Wall thickness is absolutely uniform. Tight against water, oil, steam, gas and air. Requires no maintenance. Atlantic flexible metal hose dampens vibration, remains flexible at higher temperatures.

There is an Atlantic flexible metal hose for each of these applications. Made in bronze, steel, stainless and monel—⅛"-36" I.D. with required fittings.



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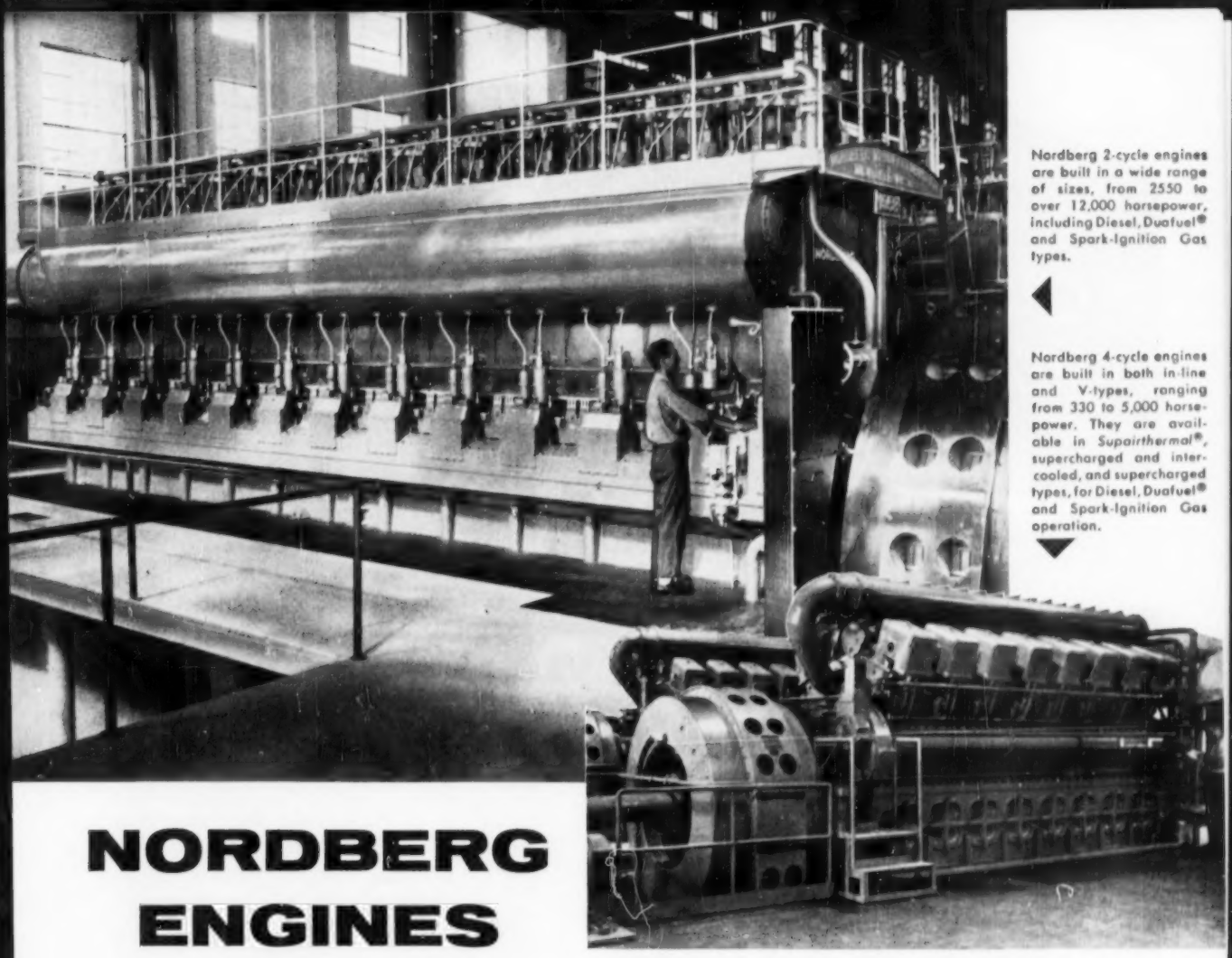

Nordberg 2-cycle engines are built in a wide range of sizes, from 2550 to over 12,000 horsepower, including Diesel, Duafuel® and Spark-Ignition Gas types.

Nordberg 4-cycle engines are built in both in-line and V-types, ranging from 330 to 5,000 horsepower. They are available in *Supairthermal®*, supercharged and intercooled, and supercharged types, for Diesel, Duafuel® and Spark-Ignition Gas operation.

NORDBERG ENGINES

Set a *New Standard of Performance* for Power Generation

NORDBERG has an enviable record of more than forty years of specialized experience in the field of heavy duty internal combustion engine design and manufacturing. The purchase of Busch-Sulzer Bros. Diesel Engine Company in 1946 brought together two of America's outstanding Diesel builders . . . Nordberg, leader in the large engine field, and Busch-Sulzer, builder of the first successful Diesel to go into regular commercial service in 1898.

Always alert to the ever-increasing demand for better, more efficient and dependable prime movers, Nordberg has continually designed and built the finest engines that modern technical knowledge, facilities and experience could produce.

This unsurpassed combination has proved, through thousands of installations throughout the world, that Nordberg Engines have set, and are continuing to set, new standards of performance for efficient, reliable, low cost power generation . . for both base load and standby power in public and private utilities, and for industry at large.

Backed by this broad experience and proved performance, Nordberg Engines are, by all standards, your best investment in modern prime movers for economical, long term power generation.

Write for further information, outlining your power requirements.

NORDBERG MFG. CO., Milwaukee, Wisconsin

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

. . . builders of America's Largest Line of Heavy Duty Engines — 10 to over 12,000 horsepower

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P756

FOR OUTSTANDING PERFORMANCE

MONMOUTH* MICRO*

MONMOUTH CLEVITE* 77

Whatever the job in your shop, you're a triple winner with Monmouth bearings. Specifically: multiple-checked precision . . . unequalled performance . . . and, throughout the complete line, the most advanced bearing engineering known today. Available from N.A.P.A. jobbers coast to coast.

*The words Monmouth, Clevite and Micro are registered trade marks of Clevite Corporation.

Monmouth

TRADE MARK

ENGINE BEARINGS

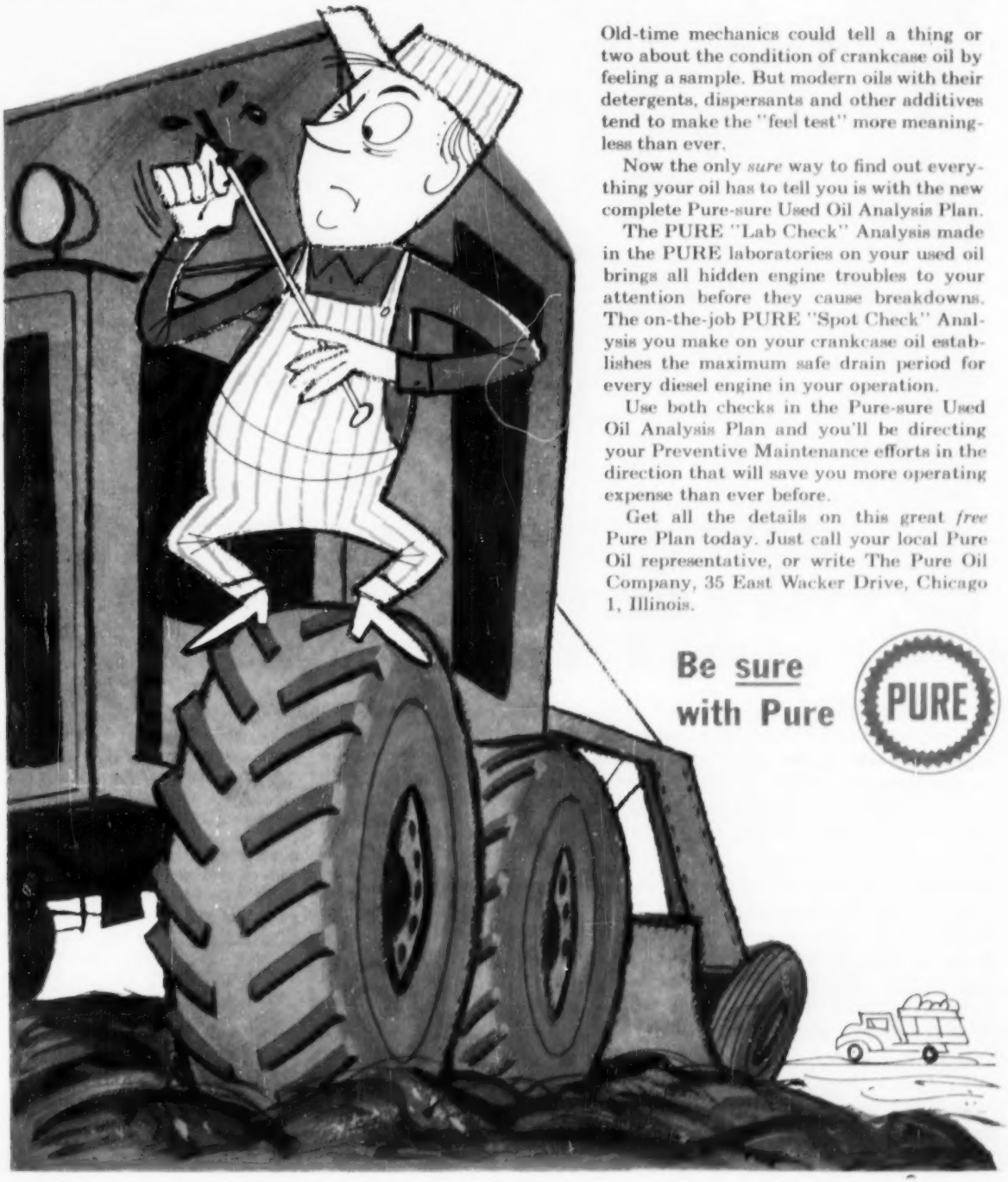
Clevite Service
The Cleveland Graphite Bronze Co.
Division of Clevite Corporation, Cleveland, Ohio, U. S. A.

NAPA Assurance of Quality

Your NAPA Jobber is a Good Man to Know!

Still Using a "Feeler" Gauge on Your Used Oil?

Get the lowdown on your lubricant the sure way—with the new PURE Lab Check and Spot Check—and save on oil, repairs



Old-time mechanics could tell a thing or two about the condition of crankcase oil by feeling a sample. But modern oils with their detergents, dispersants and other additives tend to make the "feel test" more meaningless than ever.

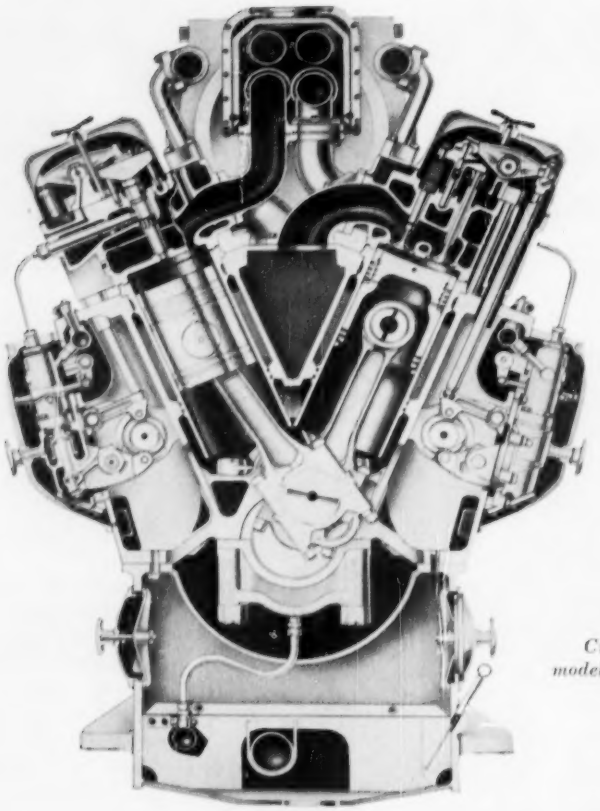
Now the only *sure* way to find out everything your oil has to tell you is with the new complete Pure-sure Used Oil Analysis Plan.

The PURE "Lab Check" Analysis made in the PURE laboratories on your used oil brings all hidden engine troubles to your attention before they cause breakdowns. The on-the-job PURE "Spot Check" Analysis you make on your crankcase oil establishes the maximum safe drain period for every diesel engine in your operation.

Use both checks in the Pure-sure Used Oil Analysis Plan and you'll be directing your Preventive Maintenance efforts in the direction that will save you more operating expense than ever before.

Get all the details on this great *free* Pure Plan today. Just call your local Pure Oil representative, or write The Pure Oil Company, 35 East Wacker Drive, Chicago 1, Illinois.

Be sure with Pure PURE



Cross section of vee model ALCO *251 diesel.*

MODERN ALCO 251 DIESELS

ARE DESIGNED FOR LIGHTER WEIGHT, HIGHER POWER, LOWER COSTS

ALCO 251 diesel engines offer light weight, high power, utmost reliability — at low cost — for all stationary and marine applications. The basic 251 engine is easily adapted, by simply adding standard parts, to pipeline pumping, marine service, power generation, oil-well drilling, power "packages" and many other applications.

Available in three sizes, in-line six, vee 12 and vee 16, ALCO 251 diesels range in horsepower from 550 to 2400. All three models have interchangeable parts for easy replacement and maintenance. ALCO has located complete parts warehouses in seven cities throughout the country, and two "repair and rebuild" centers are also established.

You get better economy. Not only in low first cost from ALCO's production line, but in low operating, installation and maintenance cost the ALCO 251 diesel can mean a real economy.

ALCO 251 DIESEL ENGINE SPECIFICATIONS

No. Cyl.	Bore and Stroke (in)	RPM Range	BHP Range	Approx. Wt. Dry (lb)
6	9x10½	350-1000	550- 900	22,100
12	9x10½	350-1000	1100-1800	32,650
16	9x10½	350-1000	1470-2400	42,000

For further information about these modern, high-powered, light-weight diesels, contact your nearest ALCO sales office or write P. O. Box 1065, Schenectady 1, New York, for a new brochure giving all details.

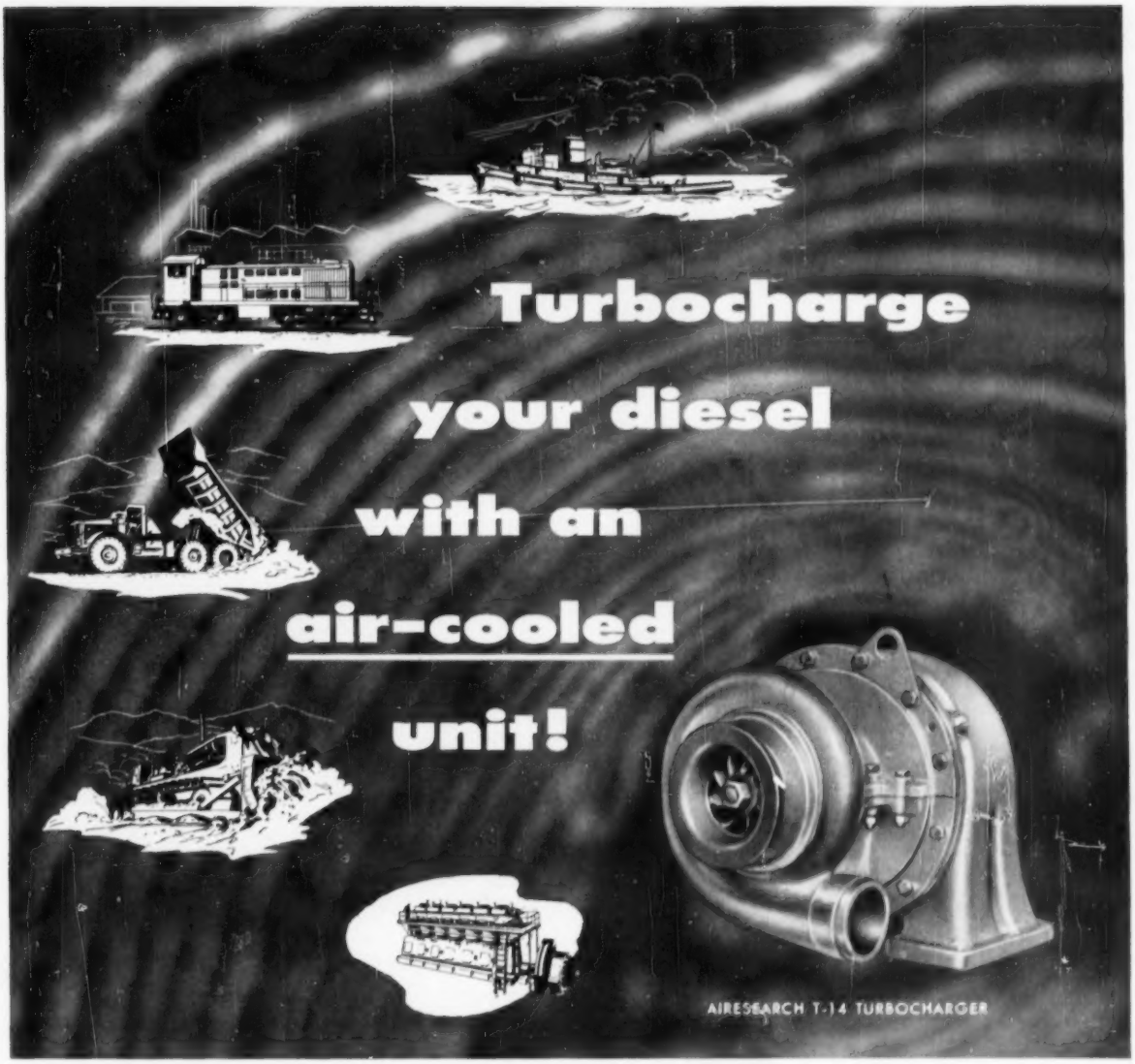
ALCO

ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment



AiResearch turbochargers increase power to the full capacity of the engine, yet require no extra plumbing and put no added burden on the cooling system.

The diesel industry generally has recognized the fuel-saving, noise and smoke reducing and power-adding advantages of turbocharging. But there are important differences between turbochargers. Some are difficult to service and add complicated plumbing because of the necessity for water-cooling.

All AiResearch turbochargers, from the smallest units for mobile equipment to the large, stationary power plant models, are air-cooled. Each contains a removable rotating assembly which simplifies maintenance, especially in the field. Their modern design resulted from the most extensive experience in the field of small turbomachinery in America.

We invite your inquiry on their application to your diesel equipment.

BASIC SPECIFICATIONS FOR AIRESEARCH TURBOCHARGERS

MODEL	T-10	T-14	T-15	T-30-2	T-30-6
Diameter — in. nom.	9	11.5	15.25	15.25	16
Length — in.	9	14.12	16.75	17.25	21.75
Weight — lb.	40	95	125	135	195
Output — lb/min. (Standard Conditions)	25-40	35-65	35-65	70-95	115-175

THE GARRETT CORPORATION

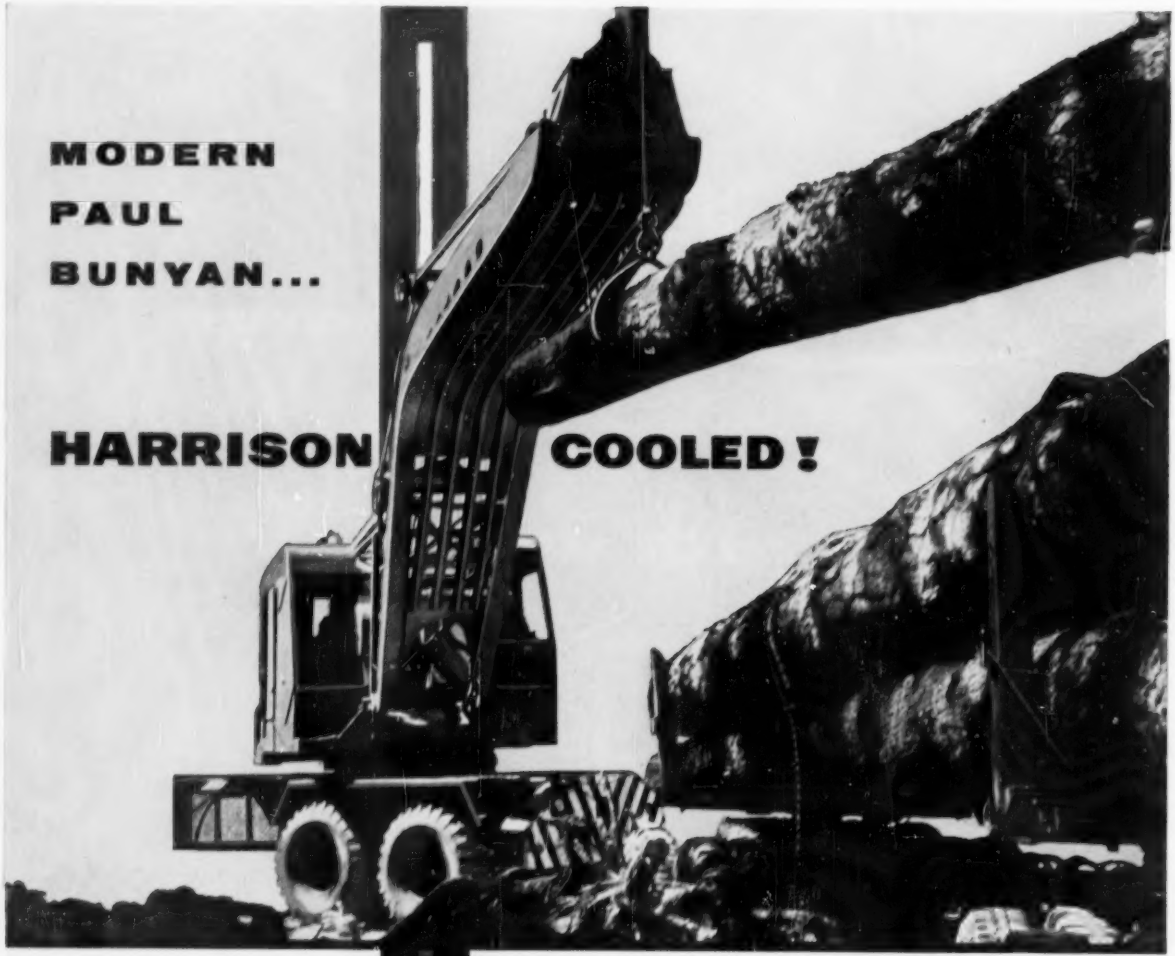
AiResearch Industrial Division

9225 South Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

MODERN
PAUL
BUNYAN...

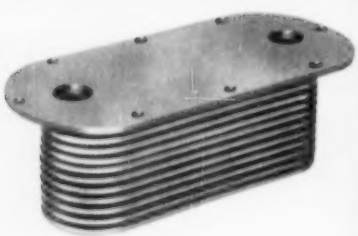
HARRISON COOLED!



Diesel-Powered Log-Loader Runs COOL with HARRISON

Heat-leveller for a mighty lumberman! That's Harrison's job on this Detroit Diesel powered Link-Belt log-loader. Hoisting huge logs day in and day out is a hot, grueling job. But Harrison's heavy-duty, high-capacity oil cooler holds heat down . . . keeps temperatures level. For temperature control is our business at Harrison—we're specialists in heat control for giant, off-the-road equipment. And that's not all . . . you'll find Harrison heat exchangers on the most advanced aviation, marine, railroad and industrial equipment. If you have a cooling problem, look to Harrison for the answer!

Watch "WIDE, WIDE WORLD" Sundays on NBC-TV



TEMPERATURES MADE TO ORDER

GM GENERAL MOTORS

HARRISON

RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N.Y.

The Engineer's Field Report

CASE HISTORY

PRODUCT Chevron Starting Fluid

FIRM Great Northern Railway Havre, Montana

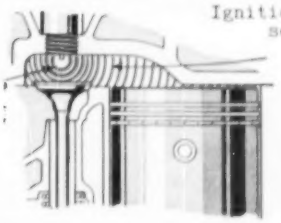
Special fluid starts 250-ton crane instantly, saves time in emergencies—even at 50° below

GREAT NORTHERN RAILWAY'S 250-TON, RAILROAD CRANE (above) starts instantly with Chevron Starting Fluid in temperatures ranging to 50° below zero—even after standing idle for months at a time. Former steam-powered wrecker equipment took crew 12 hours to start. This crane with its two 174 h.p. Cummins diesel engines is now available for derailment emergencies on short notice.

"Slow-grind starts on battery power alone waste too much valuable time. Chevron Starting Fluid fires these engines 'right now'—in any weather." A Great Northern engineer shows how simple it is to insert 7CC gelatin capsule of Chevron Starting Fluid in unit's air-intake system. Fluid is also available in 17CC capsules and 1-pint cans.

Why Chevron Starting Fluid starts engines instantly

Highly volatile: 7 times more than gasoline



Ignition temperature several hundred degrees lower than diesel fuel

Contains wear-reducing lubricants

Additives inhibit ice formation

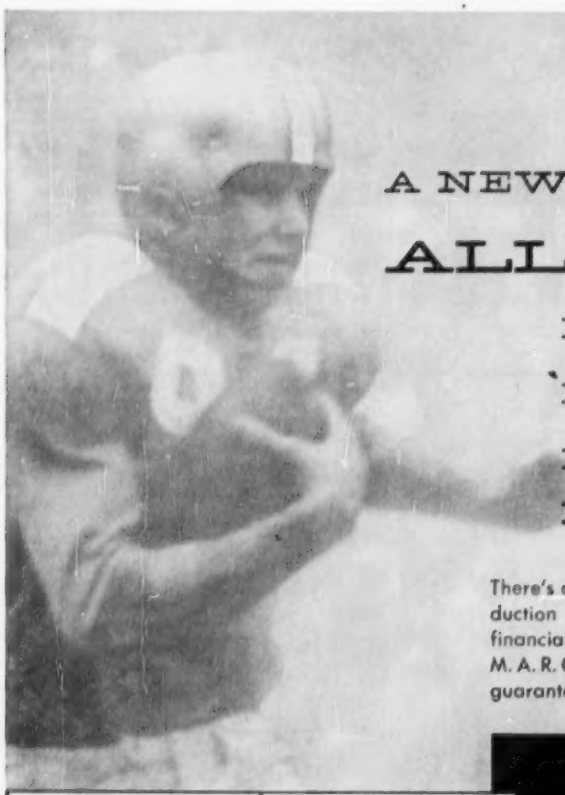
CHEVRON STARTING FLUID

FREE FOLDERS tell more about the Chevron Starting Fluid and Chevron Pressure Primer System. Write or ask for them.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor, write or call any of the companies listed below.

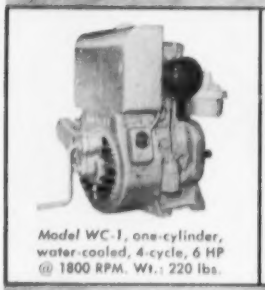
TRADEMARK "CHEVRON" AND DESIGN REG. U. S. PAT. OFF.

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • STANDARD OIL COMPANY OF TEXAS, El Paso
THE CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey • THE CALIFORNIA COMPANY, Denver 1, Colorado

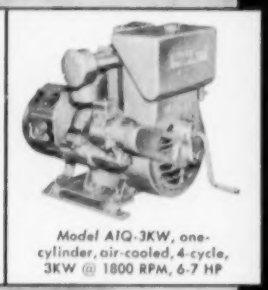


A NEW ALL-AMERICAN LINE-UP OF LOW-COST, LIGHTWEIGHT DIESEL ENGINES

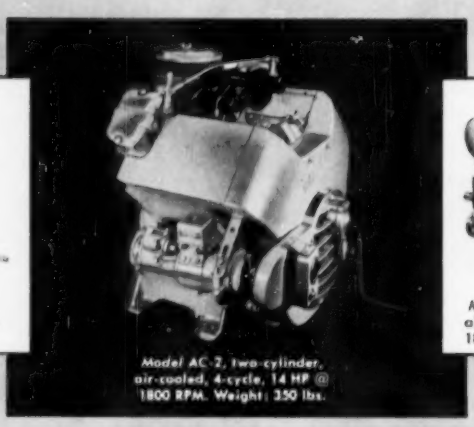
There's a new team now pulling together in the design and production of America's finest line-up of small Diesel engines. The financial strength and manufacturing experience of American M. A. R. C. is now firmly behind the line of Hallett Diesels—a guarantee that they represent greater values than ever before.



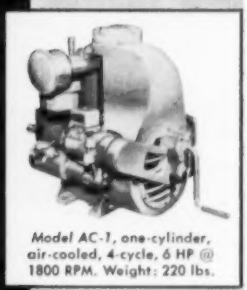
Model WC-1, one-cylinder, water-cooled, 4-cycle, 6 HP @ 1800 RPM. Wt.: 220 lbs.



Model AIQ-3KW, one-cylinder, air-cooled, 4-cycle, 3KW @ 1800 RPM, 6-7 HP



Model AC-2, two-cylinder, air-cooled, 4-cycle, 14 HP @ 1800 RPM. Weight: 350 lbs.



Model AC-1, one-cylinder, air-cooled, 4-cycle, 6 HP @ 1800 RPM. Weight: 220 lbs.

- ★ **Air or Water Cooled; 5.5 to 25 hp**
- ★ **All-American, from basic materials to completed engines**
- ★ **Available as portable power units, generating plants, pumping units, or for marine propulsion**

Mass production of American M. A. R. C. Diesels will be accelerated greatly in a new and larger plant that is now under construction. The latest in automatic processing machinery and streamlined production lines will speed the delivery of present models. Already the leader in the low power, lightweight Diesel engine field, new models to come will further strengthen this position. Some desirable sales territories are open; dealer inquiries are invited.

If you need a reliable, lightweight, full-Diesel for industrial or marine applications—or as a prime mover of powered equipment—write for literature. You'll be surprised and pleased at American M. A. R. C.'s small size, low cost, and modern "All-American" Diesel engines.

*American Manufacturing and Research Company

6-100

AMERICAN M.A.R.C.* INC.
DIESEL ENGINES

1601 West Florence Ave., Box 549, Inglewood, Calif. • Telephone ORegon 8-7174

Sharples

makes BUNKER "C" the Cheapest "Oats" for Your Diesel Horsepower

Why not take advantage of big fuel savings by burning Bunker "C" in your diesels—purified at low cost by the ultra-modern Sharples system.

Sharples has eliminated the headache of frequent bowl cleaning, and reports from users attest to the fact that engine efficiency is maintained when heavy fuel is burned.

The Sharples system pays for itself in a short time. We'll be glad to send you the facts.

SHARPLES

THE SHARPLES CORPORATION
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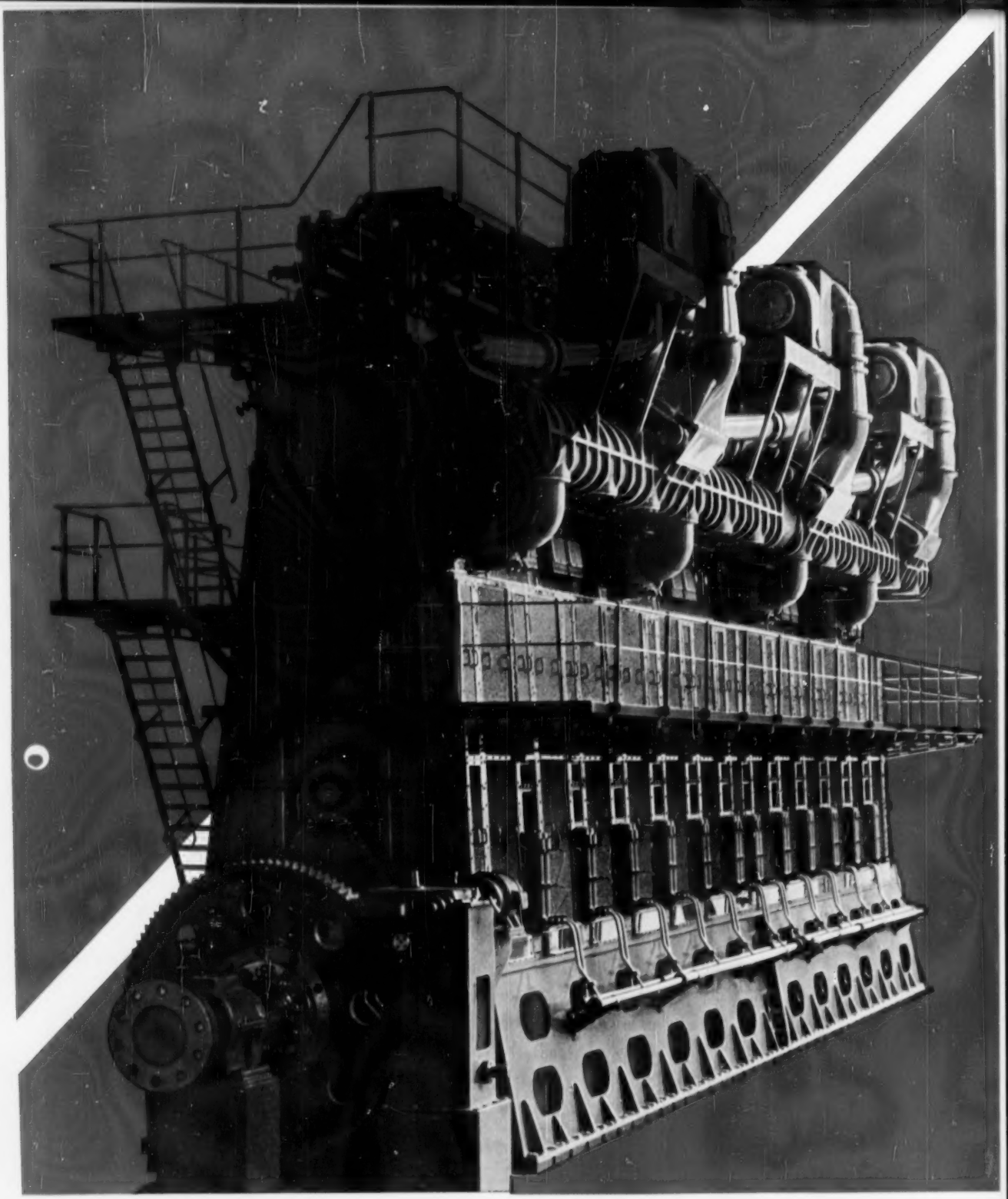
NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON
Associated Companies and Representatives throughout the World



SUPERCHARGED DIESEL ENGINES

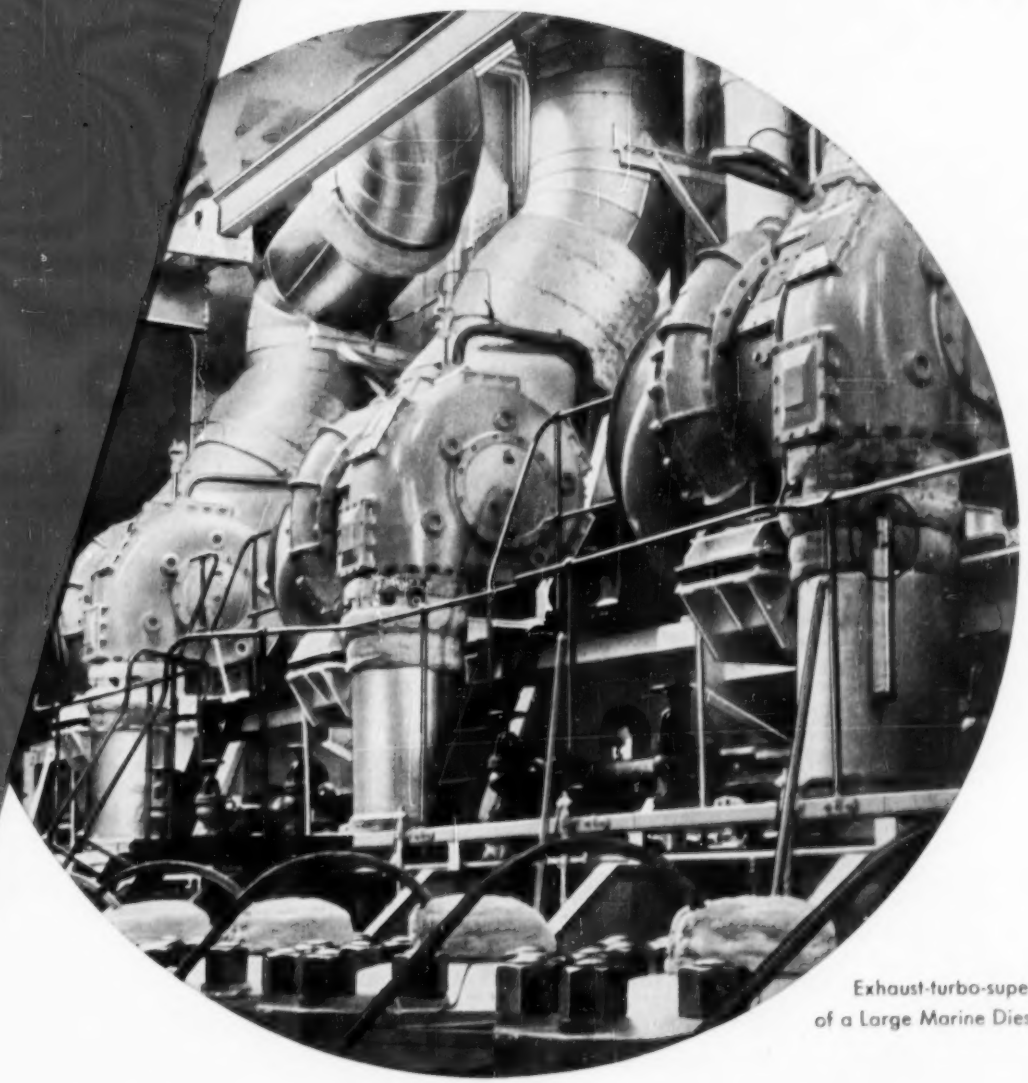
FOUR-STROKE UP TO 4,000 B.H.P.

SUPERCHARGING · HIGH SUPERCHARGING · HEAVY FUEL OIL OPERATION

TWO-STROKE UP TO 15,000 B.H.P.

SUPERCHARGING · HEAVY FUEL OIL OPERATION

M·A·N



Exhaust-turbo-superchargers
of a Large Marine Diesel Engine

M·A·N
DIESEL

MASCHINENFABRIK AUGSBURG-NURNBERG AG · AUGSBURG
Represented in all countries

In place of wasteful and uncertain crankcase-oil changing based upon hours in service, many operators now use a better guide that saves them both time and money.

Now you can test used oil in minutes

IT HAS COME as something of a surprise to some maintenance men to discover that they have been throwing away hundreds of gallons of still-good oil . . . year after year. Conversely, it is quite a jolt to realize that a costly engine-repair job could have been prevented by an on-the-spot analysis that would have shown up the condition . . . in minutes!

The recommendations for oil changes issued by engine makers have always been computed on "averages" for the various classes of vehicle service. And like the "average" man on the insurance chart, the average vehicle doesn't exist in the actual fleet. Two engines of the same make and model, operating on the same job, can have quite different patterns of oil economy and engine condition. Obviously no one set of rules can apply ideally to all diesels. And fortunately there is no longer any need for such generalization.

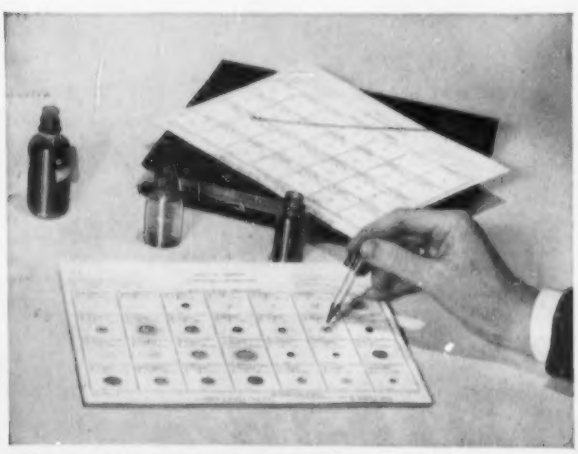
From a couple of drops of used oil, the Shell "ADC* Oilprint Analysis" provides a reliable check of oil condition, in minutes. It is very simple, and with a little practice, it tells you a lot about that oil and the engine that uses it.

What a drop of used oil shows: You place a drop of used oil on a piece of special filter paper supplied by Shell . . . let it stand a minute or two. You will then be able to *see* the following:

Water dilution: Even a tiny amount of water shows up . . . and that means not only that your oil is losing its ability to protect engine parts, but it also shows whether the water represents a normal amount of condensation or something more serious, such as an actual leakage of coolant from a faulty jacket.

Dispersancy/detergency: The same oil drop will give you a picture of how well the special additives in the oil are doing their job . . . whether or not the contaminants are being held in suspension where they do least harm . . . whether the cleansing and dispersing actions are adequate . . . whether the oil is still good.

Adulteration: The color of the oil spot will show whether too much contamination is occurring . . . and



The simple test setup: sample bottles, a wire rod, a bottle of "indicator," and the permanent record card.

This single, on-the-spot sample reveals many things about an engine.

A fleet superintendent sees how easily the test is made

will very often point up the cause, indicating a check on injectors, nozzles, oil and air filters.

All of the above can be learned from the single drop of oil . . . in an amazingly short time.

Alkalinity: Engine wear and engine deposits increase as the oil becomes acidic in nature due to contamination from combustion products. A special indicating fluid, developed in Shell Laboratories, tells at a glance whether oil is alkaline and still usable, or acid *and how much*.

Operators who keep an ADC Oilprint Analysis record of each vehicle generally find that the crankcase oil stands up longer than they had figured . . . a distinct saving in lubrication cost. At the same time, there is a running check on each engine that often detects impending trouble before its correction becomes costly. In this respect, the Shell ADC Oilprint Analysis qualifies definitely as one of the valuable recent tools of preventive maintenance.

If you are concerned with extending the service of crankcase oil, and with avoiding the risk of using oils loaded with contaminants, we suggest that you have one of the Shell service engineers demonstrate ADC Oilprint Analysis for you.

*Trademark

Photo shows an oil-spot test card...one phase in the visual life record of a charge of oil.

The Shell "indicator" shows acidity instantly. If spot turns red, oil is no longer fit to use, should be changed quickly.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

Everything in sight is
DIESEL–ELECTRIC

Six rigs—four companies—all Diesel-Electric . . . and all ELECTRO-MOTIVE POWERED

This aerial view of the yards at Orange, Texas, tells more literally than words how Electro-Motive is being accepted in the drilling industry everywhere. In this one photograph, there are six different offshore rigs in various stages of construction for four different companies. All have one thing in common: *each is equipped with Electro-Motive Diesel-Electric Power.*

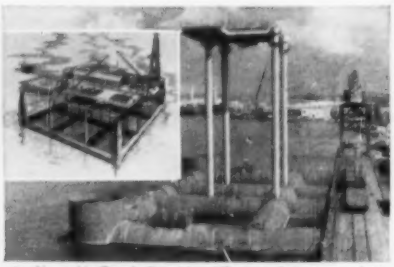
The unmatched flexibility, control and economy of Electro-Motive Power has made it the outstanding choice for deep drilling applications over water or land. See your Electro-Motive representative for complete details.

ELECTRO-MOTIVE DIVISION · GENERAL MOTORS

LA GRANGE, ILLINOIS

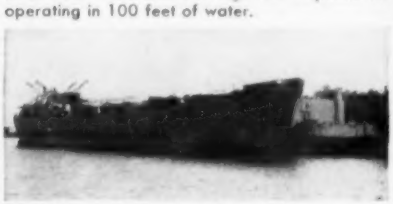
In Canada: General Motors Diesel Limited, London, Ontario

Petroleum industry sales offices: Tulsa, Oklahoma; Houston, Texas; Dallas, Texas; Morgan City, Louisiana; Pasadena, California.

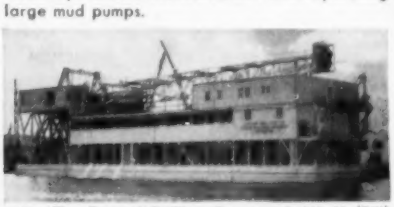


1 Kerr-McGee's Rig No. 47, a mobile type drilling device, due for completion late this year, will contain three Electro-Motive Power units.

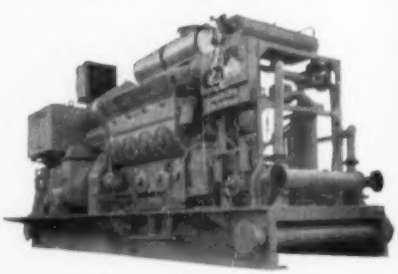
2 Rigs No. 54 and 55 for Offshore Company contain three 875 hp. Electro-Motive Power units each. These mobile rigs are capable of operating in 100 feet of water.



3 This tender, one of four being converted for a major oil company, will contain two 1200 hp. Electro-Motive Power units operating large mud pumps.



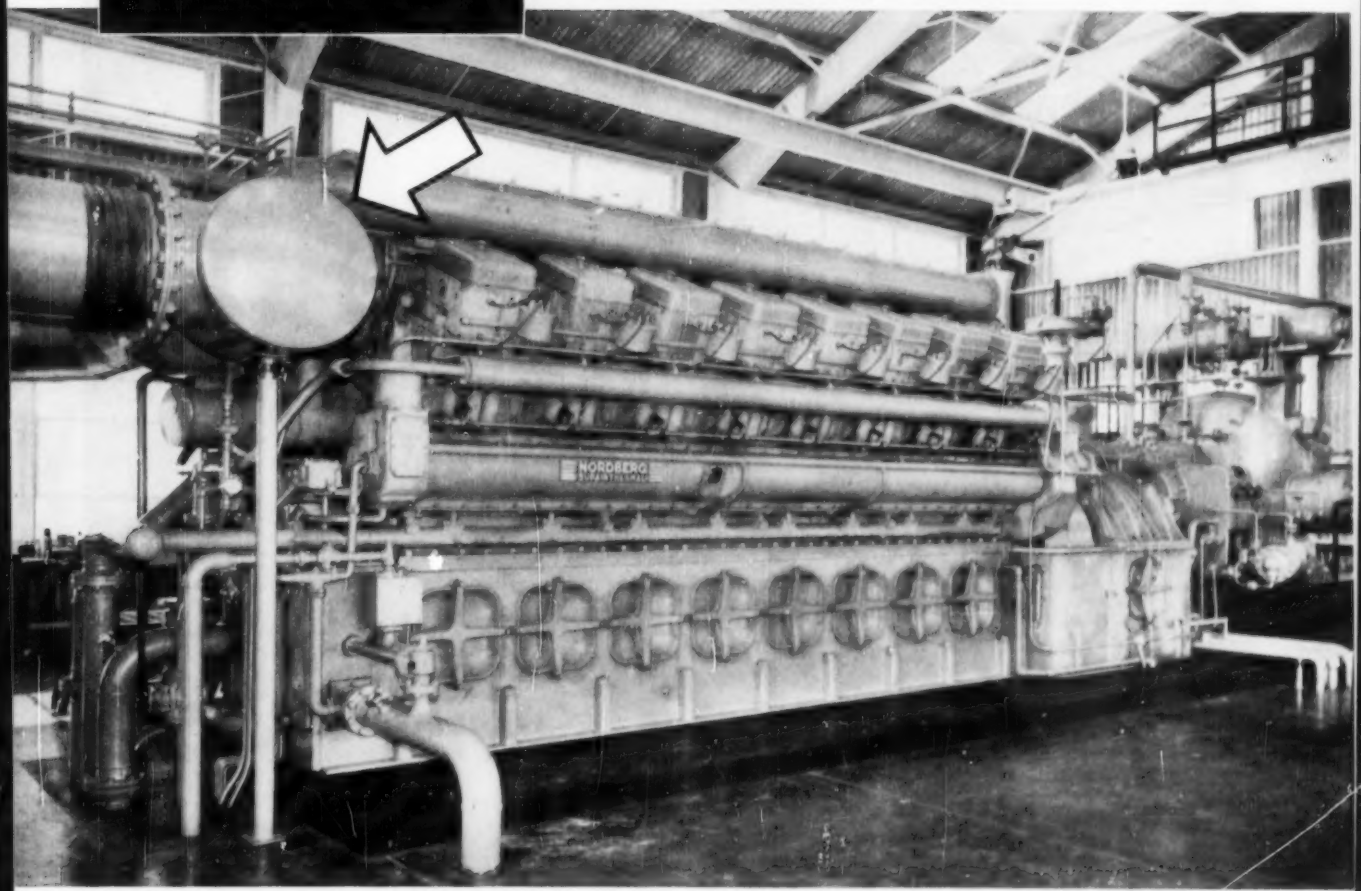
4 The Penrod Drilling Company's W. H. (Bill) Dordan and Tom Sorrell are both operating in the Gulf area for Placid Oil Company. Each contains three Electro-Motive Power units.



SR8-W 900 hp. Diesel-Electric power unit, with heat exchanger cooling. Unit includes 8-cylinder, 567C Diesel engine, all engine accessories, two 500-kw direct current generators, and generator control cabinets—all mounted on sub-steel base, 21-ft. long, 6-ft. wide and 9-ft. 7-in. high.

DE LAVAL
HIGH PRESSURE TURBOCHARGERS

double diesel output without increasing thermal loading



A Nordberg Supairthermal 3550 hp, 16-cylinder gas engine is turbocharged by a De Laval B-13 high pressure unit. This gas engine-gear set is driving a De Laval centrifugal gas pipeline compressor.

De Laval High Pressure Turbochargers utilizing a radically new design principle, can double the output of heavy-duty diesel, gas and dual-fuel engines *without increasing thermal loading.* ● As a result of the exclusive Monorotor construction, De Laval turbochargers offer pressure ratios of 3:1 as well as far higher compressor and turbine efficiencies than those found in conventional turbocharger systems. De Laval units are self-adjusting to engine loads, can be used on 4- *and* 2-cycle engines. Other Monorotor advantages are exceptional simplicity and light weight.

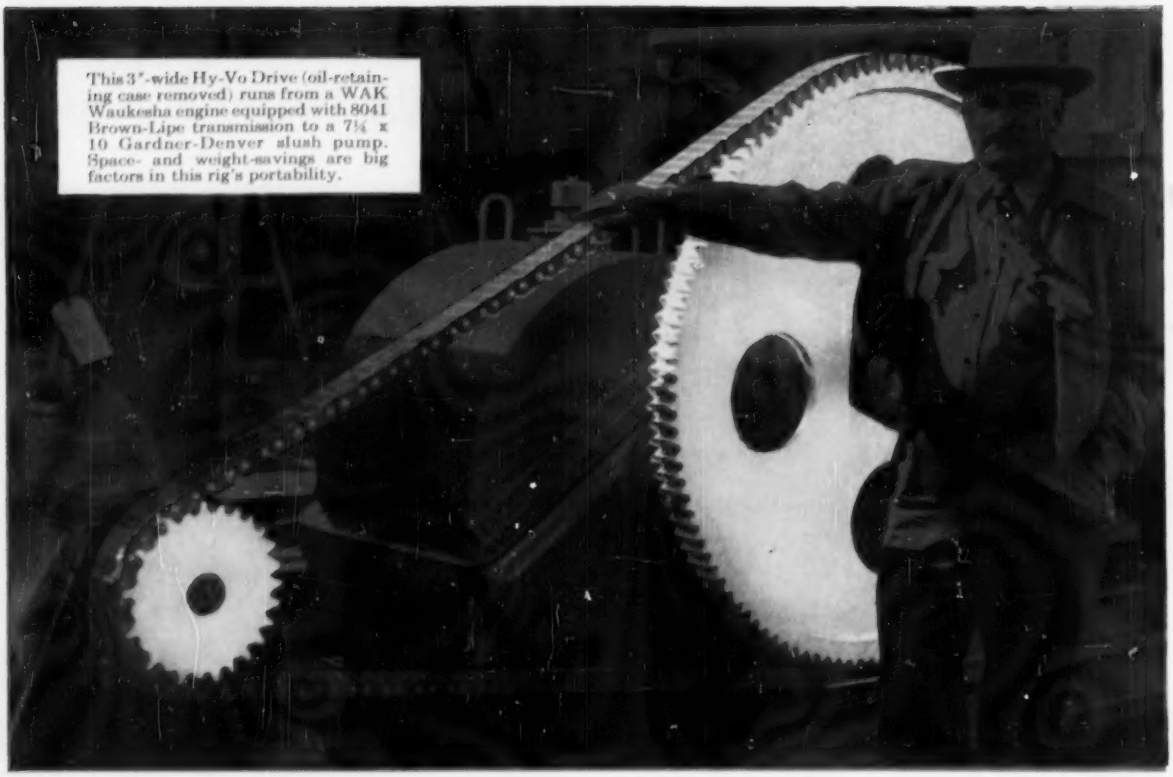
Write for De Laval Bulletin 8000 giving comprehensive curves and flow range diagrams.

DE LAVAL *Turbochargers*

DE LAVAL STEAM TURBINE COMPANY

890 Nottingham Way, Trenton 2, New Jersey

DL 348



This 3"-wide Hy-Vo Drive (oil-retaining case removed) runs from a WAK Waukesha engine equipped with 8041 Brown-Lipe transmission to a 7½ x 10 Gardner-Denver slush pump. Space- and weight-savings are big factors in this rig's portability.

Morse Hy-Vo® Drives transmit high H. P. up to 50% faster in ½ the space!

Morse Hy-Vo Chain Drives transmit up to 5,000 hp, at speeds up to 8,250 fpm. These space-saving drives take only ⅛ the space that roller chain drives, or ¼ the space that V-belt drives, would need in similar applications!

For complete information on the many economies offered by Morse Hy-Vo, contact your local Morse representative; or write: *Morse Chain Co., Industrial Sales Division, Ithaca, New York.*

WHY HY-VO MEANS LESS DOWNTIME

- Gives longer service life!
- Produces less vibration, noise and heat!
- Quickly installed without special tools!

New rocker-joint design prolongs chain life . . . eliminates joint slippage and wear. Keeps heat, noise and vibration to a minimum.

Smooth, belt-like flow of Hy-Vo at high speeds shows absence of destructive chordal action found in conventional chain drives.

Rugged Spirol Pins—standard connectors for all Hy-Vo chains—can be furnished at any interval so that chain may be quickly taken apart.

MORSE MORSE B&W *Trademark

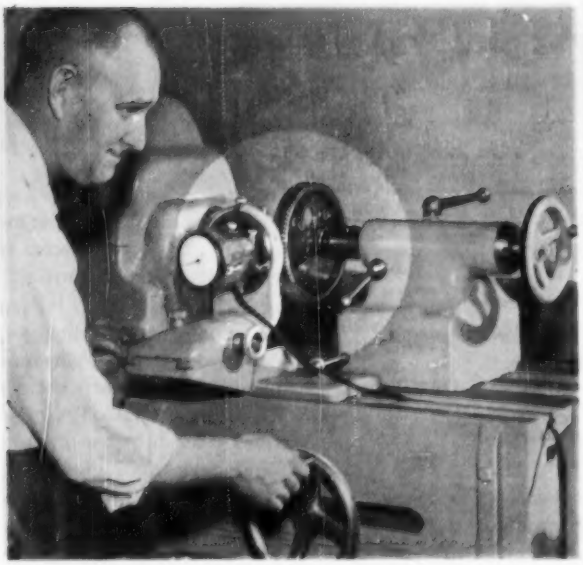
POWER TRANSMISSION PRODUCTS

GM

DETROIT DIESEL PARTS

—factory-engineered for long life, low-cost service

Camshaft inspection—Close adherence to engineering specifications on every General Motors Detroit Diesel replacement part is maintained by routine checks with high precision instruments like this optical inspection gauge with a guaranteed accuracy in millionths of an inch.



Gear dimension control—Gear teeth shaving is measured precisely on the latest-type machines where tape recordings show the contours to an accuracy of one ten-thousandths of an inch.

Magnetic analysis comparator—Here the latest electronic testing equipment is used for a uniform, rapid method in checking metal parts for strength . . . customers' assurance of utmost dependability.

You're always money ahead
when you buy
factory-engineered parts
from your Distributor or Dealer

GM
GENERAL MOTORS
DIESEL
POWER

DETROIT DIESEL

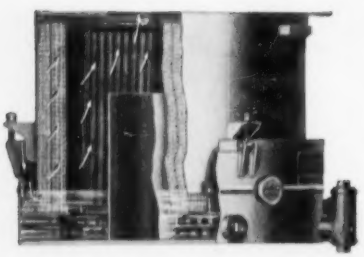
Engine Division of General Motors
Detroit 28, Michigan

Single Engines . . . 30 to 300 H.P. Multiple Units . . . Up to 892 H.P.

America's Largest Builder of Diesel Engines

REPORT FROM A LEADING MIDWESTERN RAILROAD*:

"One Air-Maze oil bath air filter **has saved $4385.79** in 27 months!"



HERE are the dollar-and-cent results of a leading midwestern railroad's 27-month test of an Air-Maze oil bath air filter. These results show the sound, economical reasons why dozens of top-flight railroads are switching to Air-Maze oil bath filters for air intakes on hundreds of diesels in freight, passenger and switching service. These are the facts from the actual report:

"Savings with Air-Maze oil bath filter for 27-month period from December, 1953 to April, 1956, are:

Reduced cost of power assembly change-outs	*$2880.00*
Reduced cost of servicing	*1505.79*
Total savings for 27-month period	*4385.79*
Annual savings	*1949.24*
Rate of return on investment for oil bath filter	*354%*

Formerly the engine was equipped with panel filters that had to be cleaned and changed once a day. The oil bath filter needs servicing only once every three months. Equally outstanding are the facts about the Air-Maze oil bath filter's efficiency. The oil bath filter is effective at *all* engine speeds—does not depend on high air velocity to do a top filtering job. It works effectively at low pressure loss . . . is not affected by humidity or oil mist conditions.

According to recent, extensive testing by an independent laboratory (which was selected not by Air-Maze, but by one of our customers), the Air-Maze oil bath filter removes 59% more fine Arizona road dust than the next best filtering device in use today.

If you want to cut both *filter* and *engine* maintenance costs as well as extend power assembly life, it's time to equip your diesel locomotive with Air-Maze oil bath filters. For further information, see your locomotive builder or write the Air-Maze Corporation, Cleveland 28, Ohio.

* Additional data furnished on request.

The biggest names in diesels are protected by Air-Maze filters

ENGINE AIR FILTERS
CAR BODY FILTERS

AIR-MAZE
The Filter Engineers

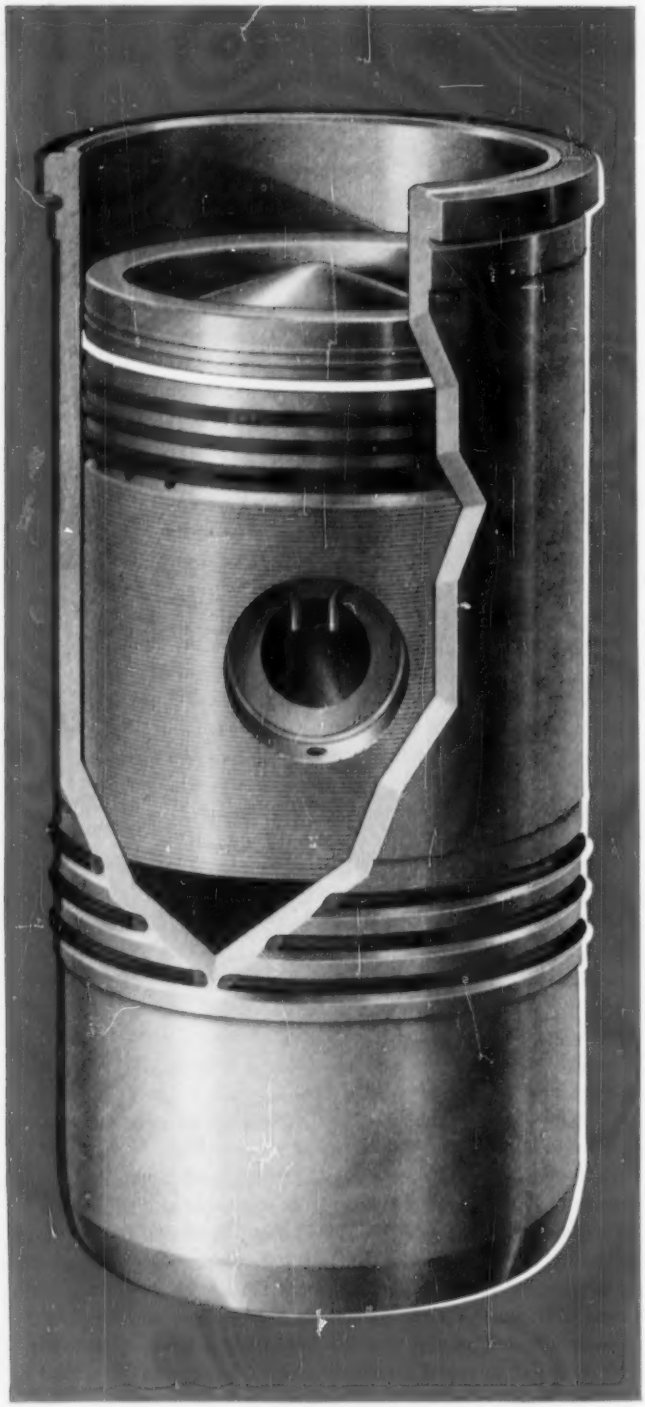
LUBE OIL FILTERS
PASSENGER CAR FILTERS

editorially speaking

A Fable for Today

In the days when oxen drew tall-wheeled carts along the caravan route, there was a smithy who was known to all. His was a reputation for honest craftmanship and long miles did men travel to benefit of his honest toil. But the iron-bound wheels gave way to new conveyances, with a diesel machine as a beast of burden. Now this man being of cautious nature was slow to change, having great regard for the ways of his fathers. But though slowly, he did change with the times. Honest unto himself and to those who did traffic with him, he did buy the best of tools to minister unto his trade. And he did lavish care on these tools, knowing that their life span would thus be increased. For he was a saving man too. As seasons passed he did turn a deaf ear to those who would sell unto him new tools. Unto them he would say, "My tools are the best and have served me well for a decade or more. I must pay my men many pieces of silver and cannot save there. But I need not the new tools and can save their cost." Unto a man selling a torque wrench he would say, "My men are good; they can tell by 'feel'." Unto one selling a power wrench he would say, "And let the electric company get fat? Who needeth them?" Or if they were powered by wind, "But the cost of a compressor! Blow!" And when one assayed to sell him a dynamometer, telling of warranty calls to be saved, he would reply, "If my man doth make a mistake, let him go forth and fix it. It serveth him right." Now many years before, this man had begat a son who coming of age, helped his sire. One day he did come to his father and with the irreverence of the times said, "Pop, we are doing a lot of business but we're losing money. I've been reading how we can save money by cutting job time. If we were to buy some . . . ." Then this venerable man did blow his top, shouting, "Buy! Buy! Buy! How can I save if I buy. Begone, seed of my loins, thou art ashes on my head." Nettled, did depart but not before muttering, "If we don't do something, we'll close our doors soon." And soon they did. As Aesop might have said, "You've got to spend a buck to make a buck; you can 'save' yourself right into bankruptcy."

B P E



Sealed Power Diesel Sleeves

combine fine engineering with complete modern manufacturing facilities

Sealed Power is a leading supplier of cylinder sleeves for Diesel engines, both for original equipment and replacement use. Sealed Power's complete modern sleeve factory at Rochester, Indiana, is the only factory in the world devoted exclusively to cylinder sleeve production. Its heat treating and precision machining equipment are without equal.

As major engineers of sleeve design, Sealed Power's staff is in the unusual position of being concerned also with the design of piston rings and pistons. Inasmuch as sleeves, pistons and rings must all work together to produce top performance, engineering knowledge of all three is necessary for top quality in each.

Because of uniform excellence in all these products, Sealed Power Sleeve Assemblies have achieved an industry-wide reputation for superior performance in the field.

Whatever your sleeve requirements, whether in standard or hard sleeves, you will find it profitable to consider Sealed Power Diesel Sleeves. Your inquiry is invited.

SEALED POWER CORPORATION—MUSKEGON, MICHIGAN—ST. JOHNS, MICHIGAN—ROCHESTER, INDIANA
DETROIT OFFICE—7-236 GENERAL MOTORS BUILDING—PHONE TRINITY 1-3440

Sealed Power Piston Rings

PISTONS • CYLINDER SLEEVES

Leading Manufacturer of Automotive and Industrial Piston Rings Since 1911 • Largest Producers of Sealing Rings for Automatic Transmissions—Power Steering Units

highlights

Petroleum producers and Refiners are located in 37 of the 48 states.

The Oil Industry is presently supplying fuel and lubricants to $20 billion worth of equipment owned by American farmers.

However, the Cost to the oil industry of finding each new barrel of oil in the ground is currently $1.08.

More About Diesel Taxis from Britain in a report from "Oil Engine" magazine (published in Britain), stating that in their opinion 70% of the total output of Austin Taxis are presently being equipped with diesel engines.

Diesels are Getting Smaller. A Sheppard diesel engine, rated 42-hp, actually takes less installation space than a gasoline engine of equal rating.

Educational Grants totaling $1 million have been made by International Nickel Co.

Bus Passengers are Safer, according to figures reported by the National Safety Council, than automobile riders. Statistics reveal that the death rate for auto travel (including taxi) was about 14 times that of bus travel.

Preliminary Study, (technical and economic) of a mobile nuclear reactor power plant for possible application to locomotives has been awarded to Walter Kidde Nuclear Lab by Baldwin-Lima-Hamilton and the Denver & Rio Grande Railroad, acting jointly.

Oil Field Germs help searchers to find where the oil is hiding. It has been discovered that certain kinds of bacteria "feed" on hydrocarbons, and if they are abundant on surface soil the odds are with you that you'll find oil underneath. One oil-service company now offers this microbe technique as an aid to producers. (From "Petroleum Newsnotes," A.P.I.).

Mechanics are Getting Scarcer. In 1940, there were 72 vehicles (trucks, busses and cars) per mechanic; in 1956 there were 87; and expectations are for 103 in 1965. This is 31 more than in 1940.

Brewery Uses Diesel Fuel, not to make the beer, but to feed the diesel locomotives that power transportation on nearly ten miles of track within the brewery. Arthur Guinnes, Son & Co. (Dublin) Ltd., now is 95% dieselized.

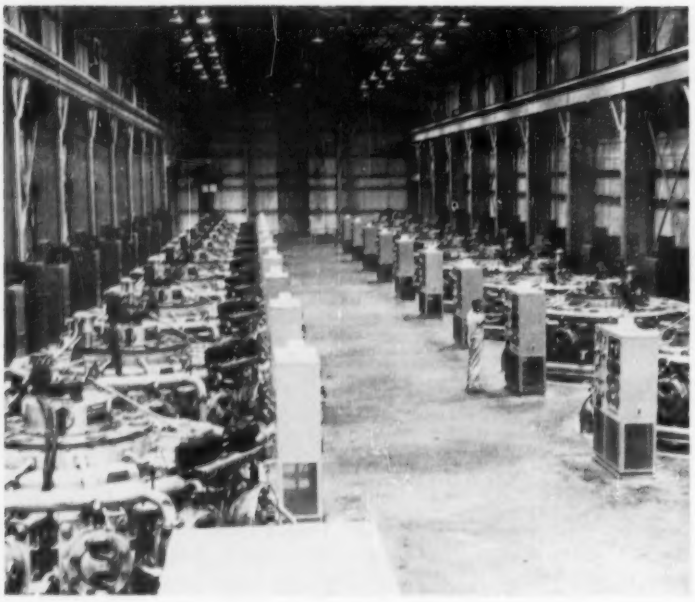
In the Other Direction, while the diesel boys are knocking themselves out finding ways to burn poorer (hence cheaper) fuels, researchers have run off the octane scale trying to measure the fancy gasolines for today's gasoline engines. ASTM's Committee D-2 now reports a "reference fuel system" for octane measurements above 100.

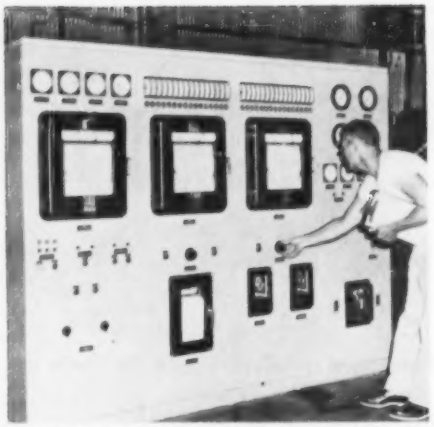
Central Air Conditioning equipment has been perfected by Le Roi Division (Westinghouse) using natural gas burning engines as power. Savings are possible because gas companies offer lower summer rates. The engines are able to save up to 50% in operating costs.

Steak plus Diesel Fuel. In 1955, 82.9% of the livestock shipped to all markets was sent by truck. Diesel, naturally, for the big load over the long haul.

The United States, with only 6.6% of the world's population, has 48.1% of its trucks and busses. Diesels power just about all the big ones, and are getting a bigger share than ever of the smaller jobs.

The Trucking Industry is responsible for today's habit of keeping to the right. Early teamsters, driving Conestoga wagons, had to sit near the brake, which was located on the left. To see the road they had to keep right. Lighter wagons tended to follow their tracks because of bad roads, and by 1813 New Jersey made "keep to the right" into law.





The first panel of this central automatic load control board has a recording voltmeter for the total load. Each of two other panels monitor the loads on 16 engines and the fourth has miscellaneous gauges.

The latest 26 Nordberg radials are installed in this powerhouse. Each engine has its own control panel, and a central automatic control board monitors the load on each engine.

More Radials for Alcoa Plant

Addition of 26 Nordberg radial engines brings world's largest internal combustion engine plant capacity to 415,000 horsepower. And there are 22 more on order. Here is a report on the results being obtained and the methods used to attain them.

ALCOA has again expanded the world's largest internal combustion engine plant. This is the third time. And they've taken steps to do it again.

As part of it's continuing expansion of aluminum production facilities, the Aluminum Co. of America recently put 26 more Nordberg radial gas engine-generator sets in service. The total number of these units now at their Point Comfort, Tex., plant is 220. But this isn't the end. Twenty-two more are to be delivered in Spring, 1957.

Background

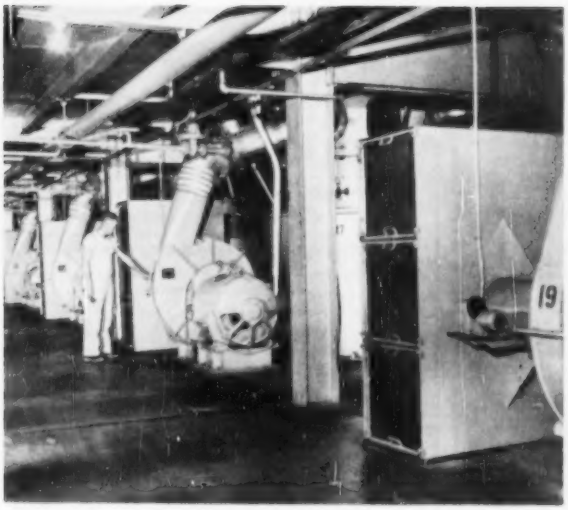
The engines, housed in six buildings, total 415,000-horsepower. They're directly coupled to dc generators which power the smelting works. The original station, completed in 1950, had 120 engines. In 1952, 74 more units were added. The last 26 units, installed in 1955, brought the plant capacity to 310,000-kw.

The recently installed units are identical to the 74 added in 1952. Each are 12-cyl, 2-cycle, spark-ignition, having a 14-in. bore and 16-in. stroke. They're rated 2125-hp at 400-rpm and drive 1330-kw, 667-v, dc Elliot generators. The dual spark-ignition system on all of these engines permits efficient burning of the low cost natural gas readily available from on-shore and off-shore wells in the area.

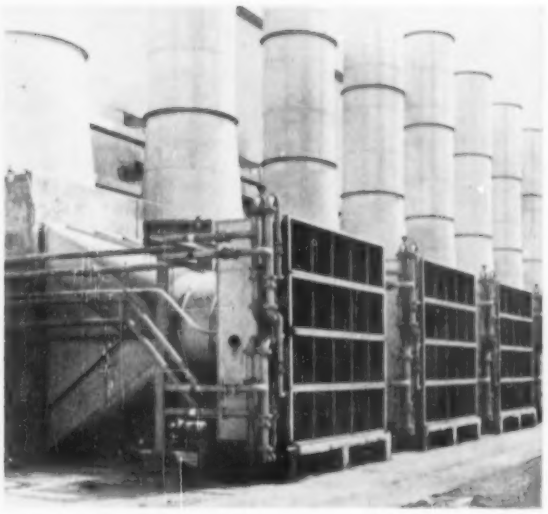
Of the six separate power houses at Point Comfort, the first three have 40 engines each. The next two have 34 each and the latest has 32, including the 26 new ones. All buildings are 500-ft. long except the newest one which is 440-ft. Other than the length, it is similar to the others in construction.

The 22 units on order will power the seventh pot line which is due for completion by January 1958. They will raise the plant capacity to over 470,000-horsepower and add 20,000 tons to the present 120,000 tons of aluminum produced annually. This requires over 4-million-kwh per 24-hr period.

These gas engines were selected by Alcoa because they could generate power at costs comparable to those for large hydro-electric plants and are more dependable being independent of the vagaries of water supply. As of Septem-



Scavenging air is washed through Airmat filters before Buffalo Forge blowers send it to engine at rate of 7000-cu ft per minute.



Each unit has own exhaust stack, generator cooling air and air from heat exchanger, foreground, which cools lube oil and water.

ber 1, 1956, the 220 engines have a combined operating time of 8,100,000-hours.

During this time, engine availability factor was 99% plus; load factor was 100-105%; and there were no power interruptions due to engine difficulties.

Additional highlights of this installation are that they: operate one year or 8760-hr between engine shutdowns or inspections; operate five years or about 35,000-hr between engine overhauls or ring changes; operate spark plugs two years, regapping only at end of first year; and lubricate antifriction bearings at three year intervals.

Maintenance

These practices just didn't happen. They are the results of preventive maintenance, the key to the successful operation of this plant. This program was outlined in an oil and Gas Power Div. paper by Mr. H. Keefer, power superintendent of Alcoa. According to Mr. Keefer, close adherence to the following basic principles have paid off:

1. Strict adherence to a schedule of planned preventive maintenance on all equipment.
2. Close co-ordination between operating and maintenance personnel.
3. Make installations as simple as possible.

A unit type of installation together with interchangeability of equipment made it relatively simple to set up all items on a definite preventive schedule. (Each engine operates as a complete unit having its independent oil and water-pump, liquid-to-air heat exchanger and other auxiliaries.)

The present program is based on scheduled outages at definite time intervals. For example, in a typical powerhouse with 40 units, 37 run, one is a spare and two are down for routine maintenance. Maintenance personnel are on the day shift only, Monday through Friday. No shift or weekend maintenance people are provided, and no maintenance work is done by the operating personnel. Strict adherence to this routine schedule is demanded—other work may be postponed but the routine maintenance must go on.

The scheduled outrages are divided into two phases—one for minor maintenance and control equipment check and one for major maintenance and overhaul.

First Phase

The first phase includes a 1-shift outage for generator and switchgear inspection every 4-months and a 2-shift outage for engine inspection every year. Work is progressively scheduled so that workmen move from one unit to the adjacent one.

Items inspected during the 4-month inspection include

Compact, lightweight radials are shipped completely assembled. These 10 wait at dock prior to loading on barge for water trip.

POWER DEPARTMENT
ROUTINE WORK SHEET

ENGINE_____ ELECTRICAL DATE_____

BLDG._____ HOUR METER_____

1. CUBICLE

_____Residual_____
_____Overspeed_____
_____Generator Temp._____
_____Neg. Breaker_____
_____Oil Temp._____
_____Oil Pressure_____
_____Water Temp._____
_____Cylinder Temp._____
_____110 V, 24 Cycle_____
_____Bearing Failure_____
_____Breaker Lights_____
_____Wiring_____
_____Probe Relay_____
_____Ground_____

2. FIELD PANEL

_____Rheostat Contacts and Brushes_____
_____Rheostat Wiring_____
_____Rheostat Stops_____
_____Main & Aux. Contacts_____
_____A.C. Bus Connections_____
_____Wiring_____
_____Ground_____

3. DB-4 BREAKERS

_____Ground_____
_____Resistors_____
_____Main & Aux. Contacts_____
_____Relays_____
_____Wiring_____
_____Residual Relay_____
_____Transactor_____

4. DISCONNECT SWITCHES

_____Jaw Adjustment_____
_____Latch Adjustment_____
_____Hinge Adjustment_____
_____Cables_____

MATERIAL USED:

_____ _____
_____ _____
_____ _____
_____ _____

By_____

5. ENGINE

_____Overspeed Switch_____
_____Ignition Gen. Leads_____
_____Transformer Leads_____
_____Conduit & Clamps_____
_____Ground_____

6. HEAT EX. CONTACTOR

_____Main & Aux. Contacts_____
_____Wiring_____
_____Mechanical Operation_____

7. BLDG. FAN CONTACTOR

_____Main & Aux. Contacts_____
_____Wiring_____
_____Mechanical Operation_____

8. PRELUBE CONTACTOR

_____Main & Aux. Contacts_____
_____Wiring_____
_____Mechanical Operation_____

9. ENGINE BASE

_____Holding Heat Sockets_____
_____Holding Heat Wiring_____
_____Bearing Failure Switch_____
_____Clearance_____
_____Gen. Temp. Thermostat_____

10. AUX. MOTORS

_____Scav. Air Motor & Gear Box_____
_____Heat Exchanger Motor_____
_____Pit Fan Motor_____
_____Bldg. Vent. Fan Motor_____
_____Lube & Water Pump Motor_____
_____Evap. Cooler Pump Motor_____
_____Lubricator Motors, N_____ L_____
_____Rheostat Control Motors_____
_____Scav. Air Control Motor_____
_____Ground Systems_____

Time Cleared_____

POWER DEPARTMENT

TROUBLE REPORT FORM 10718

Jan. 29 1956 (DATE) 1:20 A.M. (TIME)

B-7 (UNIT) #7 (BUILDING) 46926 (HOUR METER READING)

Engine Cylinder Lubricator (EQUIPMENT)

DESCRIPTION OF TROUBLE:

Seal leaking on high speed shaft. Right lubricator drive

Leakage not serious enough to remove engine from service.

J. E. Jones (REPORTED BY SIGNED)

ACTION TAKEN:

Seal replaced 1/30/56.
J.K.

PARTS OR MATERIALS USED:

1 - Seal Stock No. 2936

DATE COMPLETED 1/30/56

MAINTENANCE FOREMAN (SIGNED) A. A. Kaufman

Form 9864 - 10M - 11-51

This trouble report form is used to show special or emergency work to be done on a generator set, and the action which was taken to correct the trouble as well as the parts and materials used on job.

This power department routine work sheet is used to indicate work to be done on a generator set and to check off work that is finished. It also shows the parts or material used on job.

brushes (replaced as necessary); shutdown devices; and switchgear. Air-washer sumps are cleaned and oil sump tank baskets are checked at this time.

At the 12-month inspection, spark plugs are replaced, distributor points and spark plugs resisters are checked and the entire ignition system is examined with a special cathode-ray analyser developed by Alcoa.

Engine inspection covers are removed and rotating and reciprocating parts are visually inspected. Cylinder head water hoses are replaced. Any damaged gaskets are also replaced. The engine governor is overhauled and the overspeed governor is checked. Carbon is cleaned from exhaust ports. Instrument tubing is checked for looseness and leaks and all flange bolts are tightened. Cylinder lubricators are also checked.

As for lubrication, the heat exchanger fan motor thrust bearings and oil pump couplings are lubricated at this time. Auxiliary motor bearings are lubricated at 3-yr intervals only.

To be sure that no details are missed special check-off forms are provided. Also special trouble-report forms are used for recording non-scheduled work and shut-downs as well as special projects, tests, etc.

Second Phase

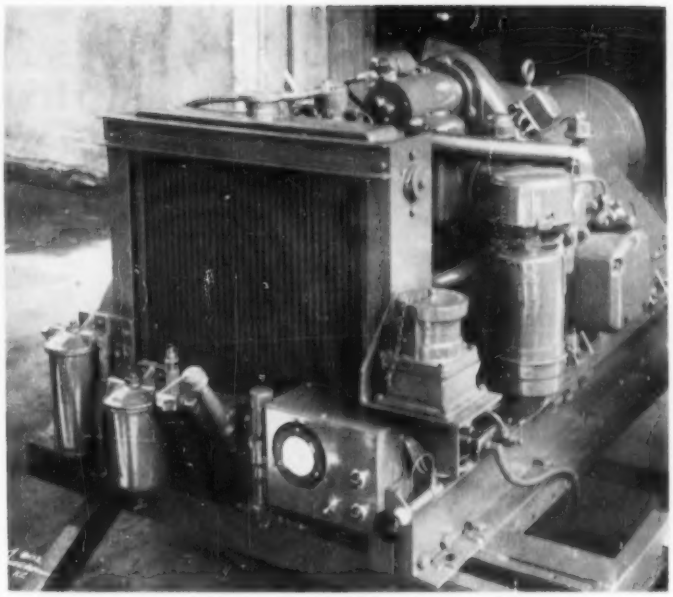
The second maintenance phase involves engine or generator disassembly. This is based on years of operation.

For example, at 5-year intervals the following is done; engine is down for one week while compression rings are replaced; oil passages and entire cooling system cleaned; bearings, cylinder bores, and journals checked; and unit exterior painted.

At 5 to 10-year intervals, generator armature and field are cleaned and insulated; commutator under-cut and ground; auxiliary motors are cleaned and insulated and their bearings cleaned, inspected and repacked. (More than 3000 auxiliary motors are in use.)

Conclusion

A program such as outlined is only as good as the persons who put it in practice. At this plant, operating as well maintenance personnel are involved. However, both phases are under one authority so that work orders, information, etc., are transmitted without the delay generally involved in passing between departments. Because of the small reserve capacity in the plant, this time element is very important.



This Witte 100RDA, 12-kw, 1800-rpm generator set is mounted on skids and is ready for shipping. Note how all auxiliaries are mounted on unit making it very compact. Yet all items are accessible.

Diesel Insurance for Refrigerated Freight

Combination Witte diesel-generator set and Carrier refrigeration unit cut initial installation costs and operational costs while providing reliability for mechanical refrigerator railroad cars.

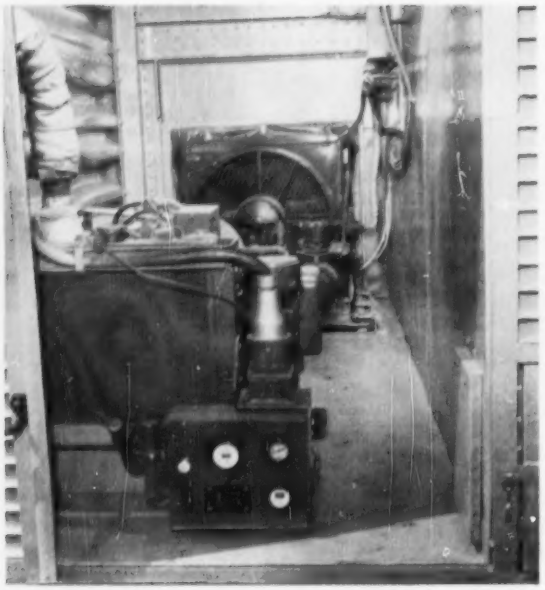
RAILROADS have made great strides through use of diesel power. Everyone is familiar with the economic success of diesel locomotives. Today the diesel again is called upon to play an important role in railroad service—this time in mechanical refrigeration. The trend as illustrated by the frozen food industry, is developing surely and at an increasing rate.

Railroads require equipment that will function efficiently under the most rigorous operating conditions. In many cases load value far exceeds the cost of the car itself.

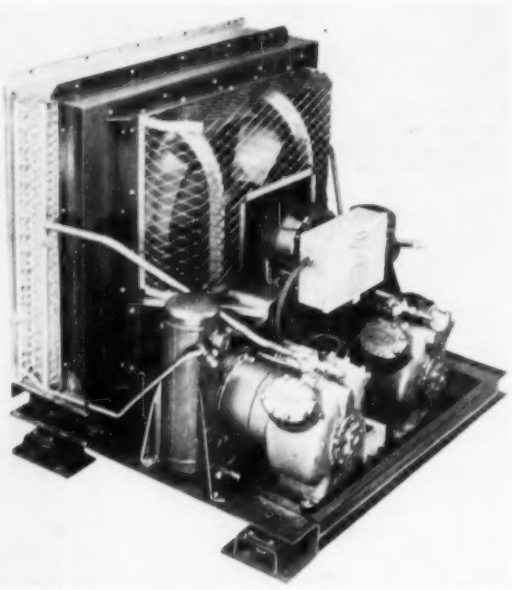
Operational, maintenance, and first costs must be considered; especially since many thousands of these cars are necessary to efficiently serve the nation's needs. To select equipment best fitted for the job, the railroad industry has used data obtained from test applications. Various arrangements and combinations of power sources and refrigeration equipment are being continually explored. In addition, manufacturers of the various components have been conducting exhaustive tests in correlation with the industry.

As an example, the Witte Engine Works of Kansas City, Mo.—a part of the U. S. Steel Corp.—collaborated with the Carrier Corp. to determine adaptability of a model 100RDA Witte diesel generator unit for powering the Carrier 66E-3 railroad refrigerating unit. On the basis of these findings, Carrier recommended a test application to the Pacific Fruit Express Co. of San Francisco. Car PFE 300290, now operating out of Roseville, California, was selected for the installation by the Pacific Fruit Express Co.

A 20-kw diesel generator set which had previously been used to power the Carrier unit was removed from this car to make the new installation. In this installation the Witte series 100 diesel is direct-connected to a 12-kw, 1800-rpm Delco alternator. This is a 4-in. bore, 4-in. stroke, 4-cycle, 2-cyl diesel with a continuous rating of 18-hp at 1800 rpm.



This Witte 100RDA generator set powers the Frigidaire refrigerating unit installed in the Fruit Growers Express Co. car FGEX 208.



The 66-E Carrier refrigerating unit in the Pacific Fruit Ex. Co. car PFE 300290 has two 7½-hp semi-hermetic compressors.

The height is less than 30-in. from the car floor permitting the use of the unit in installations with limited head room. It is 68-in. long, 39-in. wide and weighs about 1700-lb.

The unit's horizontally-opposed cylinder design results in an extremely well-balanced, smooth running engine. The two piston and rod assemblies are mounted on diametrically opposite throws of the crankshaft, and therefore, inertia forces resulting from their reciprocating motion conteract each other. The cylinders fire alternately, providing a power stroke with each engine revolution.

Wide spacing of large support pads assures a stable and secure mounting arrangement. These pads are located immediately below the crankshaft centerline and close to the engine's center of mass. This feature assures positive engine anchorage which is important in high-speed transport equipment subject to severe shock. The unit is built to withstand shocks in excess of 15-G.

Outstanding features include: wet-type replaceable cylinder liners; precision aluminum bearings; replaceable valve guides, stellite-faced valves, stellite valve seat inserts; dynamically-balanced, forged-steel crankshaft; and full-pressure lubrication.

The conversion was accomplished on car PFE 300290 using the original electrical controls, 1-hp evaporator blower motor and the 2-hp condenser motor, so that the kilowatt requirements were constant for either the 66-E-1 or 66E-3 refrigeration systems. The 66E-1 condensing assembly is equipped with two 7½-hp open-type compressors. The 66E-3 has two 7½-hp semi-hermetic compressors.

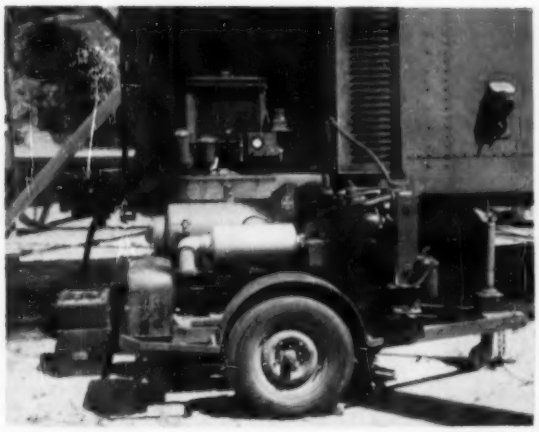
The Witte-powered railway refrigeration unit designed by Carrier is capable of high capacity performance with relatively low power requirements. Several years of research were spent to develop this compact efficient unit with low equipment costs and operating expense.

The present Carrier refrigerating unit, using Freon 12 refrigerant, evolved from an original design using two 3-cyl compressors, to a system having two 6-cyl compressors while maintaining the same total displacement. The latter combination requires less starting torque, which is the biggest single drain on the electric power source. Because of this reduced power drain, the generator can be more closely sized to the actual running load requirements.

The change from a 20-kw unit to one of 12-kw was accomplished with no loss in efficiency. A condition of high initial loading is imposed upon any refrigeration system during the "pull-down" period, especially when the car and load is exposed to extremely high ambient temperatures. A special expansion valve, which limits back pressure to the compressors during the initial pull-down, overcomes this problem.

These refrigerator systems are for "all-purpose" use because they heat as well as cool. A constant temperature is maintained in the cars regardless of outside temperature changes encountered in transcontinental runs. The refrigerating capacity is engineered to provide available inside-car temperatures from —10° to 70° F. A thermostat controls temperatures by permitting operation of both compressors at high loads or only one under moderate loads.

The units are designed to "think for themselves" with an automatic defrosting device that trips an electric heater



An exact duplicate of the Witte generator set in the car is trailer-mounted so it can be quickly transported at high speed for use at check points and sidings during inspection and servicing of the refrigerator car engine or in emergency.

into action when the cooling coils become frosted enough to interfere with air flow.

The experimental unit performed successfully under all conditions since its installation in the PFE car in March 1956. As of September 1, 1956, this car completed 10 trips with a total of 2544 engine hours of operation. A substantial number of these Witte-powered units are now on order as part of PFE's latest construction program.

Not only is this unit of the correct physical size and horsepower rating, but when compared with other units, the initial cost is less and fuel consumption is lower. A further saving in fuel cost can be realized by using a No. 2 diesel fuel, instead of a No. 1 sometimes specified for other diesels.

Another company that saw similar benefits from the use of a Witte-powered refrigerator unit was the Fruit Growers Express Co. of Washington, D.C. A 40-ft, 50-ton, Frigidaire-equipped, mechanical refrigerator car, FGEX 208, was selected by Fruit Growers Express for the installation. This car had been built in Alexandria, Virginia, in 1953. It was designed to handle fresh fruits, vegetables, and other products at controlled temperatures ranging from 30° to 70°F.

On June 9, 1955, a new mechanical refrigeration system was put into the FGEX 208. It consists of a single 5-hp sealed compressor-condensing unit and the above-discussed Witte Model 100RDA diesel having a directly connected 12-kw alternator.

Since this car has been in experimental service, its performance has been closely followed to determine how well it would stand up under actual operating conditions. It has now accumulated almost 3000 hours of operation and has carried more than 13 commodity loads. All experience with this unit during actual operating conditions indicate that it satisfactorily fulfills the standards of performance and dependability required for this rigorous service.

C-B's "Series" Turbocharging

CUTTING engine horsepower loss at altitudes above 1500-ft has been a challenge to engine builders for a quarter century. Considerable research has already been undertaken by the entire engine building industry.

Marked progress was achieved by one engine builder, the Cooper-Bessemer Corp., only after they decided to build both the engines and the turbochargers as a joint research project. This made it possible to co-ordinate turbocharging characteristics with the exact engine needs of engines themselves.

Derating engines for high altitudes resulted from inability of engines to "breathe" sufficient air to burn all the fuel the engine would take. Some auxiliary means is required to supplement the loss of combustion air in rarified atmospheres.

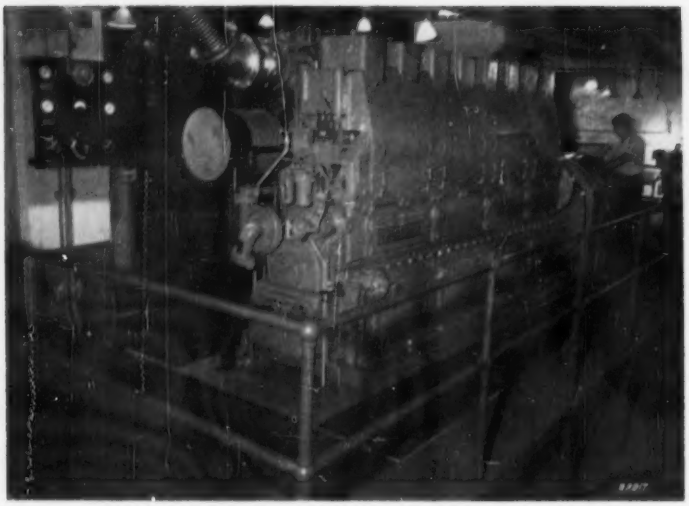
C-B engines now using their newly developed "series" turbocharging for maintaining sea level rating at any altitude have been in operation over a year and a half.

Through this supercharging development, C-B's 4-cycle engines can operate at any altitude with no sacrifice in output whatsoever, according to Ralph Boyer, vice president and chief engineer of C-B. Two-cycle engines will also be able to operate at 7500-ft without any deration in horsepower.

The new supercharging system is available for both new engines and for many of those in the field.

Additional benefits are being realized by C-B's newest advancements in turbocharging technology. For example 10-20% savings in fuel consumption are predicted for many applications. With greater adaptability to high altitudes, fewer engines will now be needed to develop power requirements. Furthermore, a predicted increase of 20 to 35% in engine horsepower will become available at no additional increase in cost per horsepower.

Savings in building costs through fewer foundations, less space and simple auxiliary equipment are expected to help offset rising costs in manpower and materials in power station construction.



Selector switches, shown above, take a lot of energy, as do relays, vacuum tubes in repeaters, etc.

Air starting is used for all diesels. Practice is to have a pair of tanks fully charged to 250-psi, ready to start. Left, I-R type-30 high-pressure compressor.

Standby Power for N. Y. Telephone

By R. T. Maus—Ingersoll-Rand Company

Telephones need power. When power outages could spell trouble, 3325-kw of I-R diesel power helps shoulder the load.

TELEPHONIC communications take power—lots of it. Generally this is obtained from an outside source. But let's face it, dependable as power supplies are today, they still are vulnerable to natural and man-made disasters—floods, hurric es or bombs. And, when catastrophe strikes, that's when 'phone service is needed most.

All over the country telephone engineers are taking steps to insure the continuation of service in time of need by installing stand-by generating capacity — much of it diesel powered. Its a tribute to good management, good engineering and lots of well-done jobs that we aren't often without our 'phone service.

New York Telephone Company

One example is the N. Y. Telephone Company and specifically some of its exchanges which serve the world's largest metropolis. New York City has more telephones than any other city in the world. More than those placing second (Chicago) and third (London) combined. More even than any country except Canada, the United Kingdom and, of course, the U. S.

On the average there is one telephone in N. Y. C. for each 2.15 persons. (Washington, D. C., leads the world with one for each 1.62 persons.) On a statewide basis, two-thirds of all telephones owned by the Bell System affiliate are in or immediately adjacent to the five boroughs of N. Y. C. The 4-million 'phones in that area are served by 312 exchanges. And, as U. S. leaders warn, N. Y. will be a critical target area in case of war.

One of the greatest advances in telephony was the development of "common-battery" service in which all telephones in an exchange are powered from the central office. Prior to that development each instrument had its own power source—a battery of two 1½-v dry cells to energize the voice circuit and hand cranked magneto to supply ringing current.

The principal step in the development of "common-battery" systems was to move all individual batteries to the central office and it is by battery current that most telephone exchanges are powered today. The battery cells are kept charged at all times by current from local electric utilities. If power fails, standby diesels can be

started up within seconds to furnish enough power for recharging batteries and emergency equipment.

History of Standby Power

Standby source of power for a telephone exchange is not new, at least for many of the Manhattan exchanges. As early as the 1920's gas engine-generator sets were installed which used city gas supply for fuel. The disadvantages of an outside fuel source were immediately apparent, and, after several years, some of the exchanges were equipped with gasoline-engine-powered generators.

However, the nature of the service called for really heavy-duty and dependable engines. For example, there may be no need for emergency power for several years, yet when the need arises the units have to be started immediately and operate at full load continuously until normal outside power is resumed.

The N. Y. Telephone Co. began to look into the inherent advantages of the heavy-duty, stationary diesel engine in 1936. Soon the first orders were placed for diesel units and in 1937 some New Yorkers had the continuity of their service insured by the first diesel-electric standby installation. Today, emergency service can be sustained in every exchange on Manhattan.

The majority of standby installations in the city are on lower sub-floors of buildings, out of harm's way. Many are completely self-sufficient for periods of one week or more. Some of the earliest units installed depended on city water for cooling. But many now are converted or are being converted to independent operation by means of a closed coolant system incorporating fan cooled radiators.

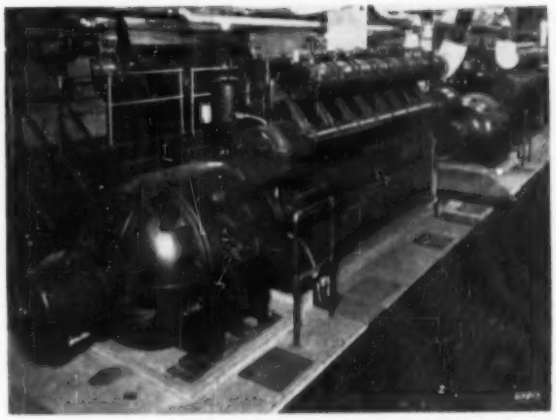
First Installation

One of the first exchanges on Manhattan to be equipped with a diesel-driven standby generator was the one at 104 Broad Street in the downtown financial or Wall Street district. The engine is an Ingersoll-Rand Type S unit and drives a 300-kw General Electric generator.

A duplicate unit was installed just 10 years later in October, 1947. Both engines are 6-cyl units operating at 720-rpm. The last large engine to be installed in Manhattan was at 435 West 50th Street. This was an 8-cyl naturally aspirated I-R diesel connected to a 625-kw GE generator. Provisions have been made to supercharge this engine when power requirements increase. Other I-R engines (a total of nine on Manhattan alone) provide emergency power for many other exchanges. Together they total 3325-kw.

All engines are started with compressed air at 250-psi pressure by admitting the air directly to the power cylinders in firing sequence. Air is furnished by an I-R Type 30 compressor. As soon as the units reach operating speed, full load is imposed—there is no warm-up or stabilization period allowed.

To make sure that each engine is in operating condition at all times, they are run for 1-hr period each week; an 8-hr period each month; and once each quarter are put through a 9-hr stint. Careful records are kept of their performance during these runs.



Two of the nine I-R diesel engines serving as standy-by units. Engine shown above is an 8-cyl, 600-hp unit direct-coupled to a G. E. 400-kw generator. Engine was installed in 1954.

Economics of The Problem

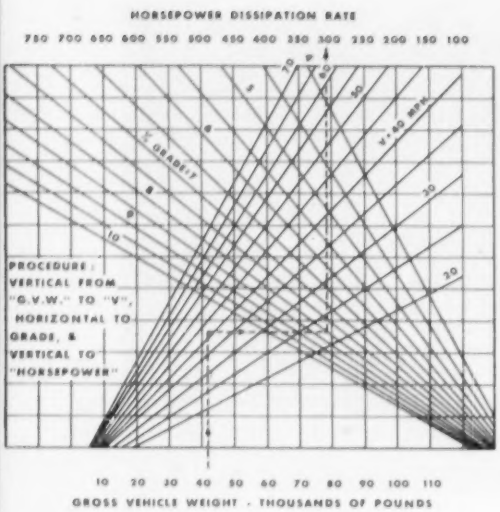
From an economic standpoint, installing large, heavy-duty units of this type is an expensive operation, especially when it is considered that the units may not be needed for several years at a time. Yet, although no figures are available to prove or disprove it, since the diesels insure against power outage, the engines may pay for themselves many times over in just one short period of operation.

Maintenance, too, could be a big item on engines operating under these conditions. In fact, many diesel engineers claim that an engine suffers more when it is not running—is on standby service—than if it were running all the time. The latter is one of the primary reasons why N. Y. Telephone Co. engineers chose heavy-duty diesels.

For example, some condensation occurs in all engines when they stand idle. The amount of damage done by this water is dependent on the thickness and type of metal in the engine. Thus, it was felt that the heavy-duty type engines would stand up better in this application.

Conclusion

A cardinal rule of the Bell System is that, although machinery plays an important and continually growing role in the provision of telephone communication, the business essentially remains a service that is performed by a few people for many others. The importance of people to the dependability of the service rendered by N. Y. Telephone Co. is shown in the results of a special training program which by the end of 1955 had fitted more than 10,000 of the company's 81,000 employees for special civil defense and emergency duties.


HORSEPOWER DISSIPATION RATE
750 700 650 600 550 500 450 400 350 300 250 200 150 100
V = 60 MPH
% GRADE
PROCEDURE:
VERTICAL FROM "G.V.W." TO "V",
HORIZONTAL TO GRADE, &
VERTICAL TO "HORSEPOWER"
10 20 30 40 50 60 70 80 90 100 110
GROSS VEHICLE WEIGHT - THOUSANDS OF POUNDS

Your engine will get you up the steepest grade without any trouble; but your service brakes are not enough to get you down—without high maintenance and replacement costs. The horsepower generated (chart at left) is too much for service brakes to handle. Retarders speed work cycles and save money, too.
Photo—Warner Electric Brake

Retarder Roundup

Horsepower pulls heavy weights up a hill—the faster you go up the more you need. Modern diesels can supply the power to take you up, but equivalent braking horsepower is needed on the downgrade, and service brakes have their limitations. One answer to higher, controlled downgrade speeds are retarders.

TODAY'S powerful diesels were designed to increase vehicle capacities and speed turn-around cycles. They'll pull the loads up steep grades, but getting down again is another story. It's all up to the brakes.

If the full potential of vehicle power is to be realized, higher—but safe—controlled downgrade speeds must be achieved. A loaded truck rolling down a grade takes a lot of stopping. Get it rolling faster and it takes more power to stop it. And there is a limitation to brakes.

Actually the restrictions on brake area that can be put in the wheels—permissible unit loading and the temperatures involved—are all factors in limiting downgrade speeds that can be handled. Stopping capabilities, rather than vehicle design and handling are the controlling factor. Then there is the matter of lining wear and damage to drums, both maintenance cost items.

So any supplementary method of supplying stopping power by absorbing momentum energy leaves the service brakes a margin of safety. Downhill speeds can then be higher with good control and safety. Maintenance costs will be cut, too.

Railroads were once up against the same thing. Controlling train speeds on long downgrades literally ground tons of metal off brake shoes in addition to wearing wheels.

They solved their problem by dynamic braking. This converts the power output mechanism into a power absorbing unit. When descending a grade or slowing, the normal direction of torque is reversed and a steady restraining force is applied.

The principles can apply to train or truck. In the case of the latter, the supplemental braking devices are called retarders.

Basically, retarders are devices or systems designed to absorb the considerable amount of energy produced by the snowballing motion of a vehicle rolling downhill. Provision is made for the safe dissipation of this energy in the form of heat. They are designed so that their power absorbing capacity at various speeds is reasonably in line with the accelerating forces acting in the vehicle. Thus, vehicle speeds can be safely controlled with only a nominal portion of the work being done by the friction service brakes.

Types of Retarders

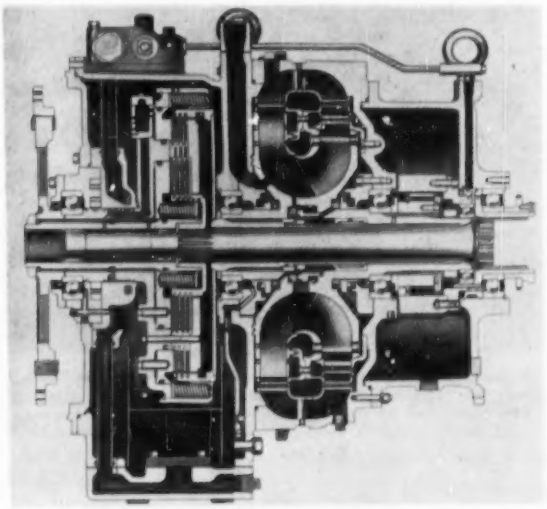
Retarders may be roughly classified into three groups. These consist of the hydraulic type, using fluid dynamics for braking; compression type, which uses the engine to brake the vehicle; and the electric retarder, utilizing electrical phenomena to produce counter-torque. Each of these types has certain advantages, making it the best answer for a particular application. An examination of types will aid in making the correct selection.

Hydraulic Retarders

In general, hydraulic retarder action resembles that of a perpetually stalled fluid coupling or torque converter. The full input-energy is absorbed by the pump, and since no work is done, energy is dissipated in the form of heat.

After the fluid absorbs the heat, it is circulated from the retarder unit to a heat exchanger. After cooling, it's returned to a reservoir for reuse.

A hydraulic retarder need not be installed as an individual unit, but may be made integral with a torque converter. This gives the benefits of both in a single package. Twin Disc, for example, offers two versions.



Twin Disc direct-drive model DF, three-stage hydraulic torque converter with inbuilt braking feature. Oil-actuated clutches (left center) engage to combine converter and engine braking.

The model DF is both an on and off-highway unit. In order to actuate the retarder, the driver must flip a switch located near his fingertips. In addition to torque multiplication, the converter design provides for direct drive and converter braking. Two hydraulically operated concentric clutches are ahead of the converter.

However, when the switch-valve is moved to the "braking" position, both the inner and outer clutches become engaged. The wheels now drive the converter, the direct drive shaft, and the engine is pulled along. Thus, a combination of friction, engine compression and energy absorbtion by the converter-impeller act to absorb the torque.

The other model, the "CF", is the more specialized version. It is engineered for off-highway application on heavy-duty short-haul trucks operating on acutely-steep grades. Unlike the "DF", here, the retarding action is applied automatically when pressure is removed from the accelerator.

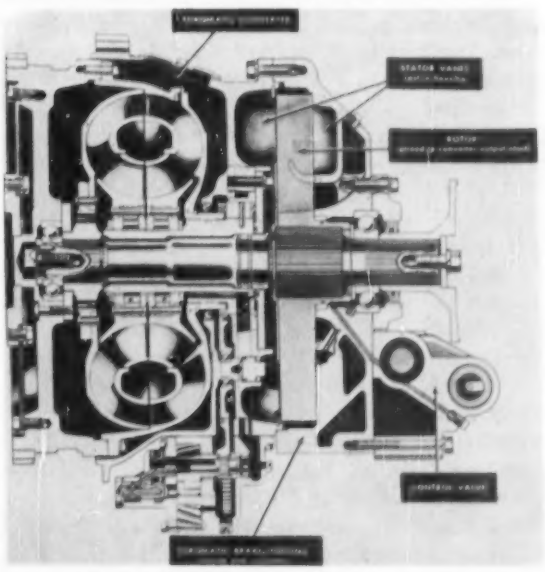
Releasing the foot pedal engages a freewheel, mounted between the impeller and turbine. This locks the two elements together, having the effect of direct-connecting the engine to the wheels. Also, this lockup provides for absorbtion of braking horsepower by the converter. Twin Disc claims that this unit applies as much as 90% rated engine-power as retarding torque.

The retarder-converter combination has shown good results in the field. It has on occasion solved a problem for a truck operator, as it did in the case of the Hammond Lumber Co.

These off-highway trucks had to operate over rough roads, on down-grades as steep as 11%. The rugged conditions caused an unusually high amount of brake-drum breakage and lining wear.

Model CF converters with full-time retarders were installed, and the results began to show almost immediately. First, production picked up. Second, brake maintenance declined sharply, and tire life showed a surprising increase.

Allison's Torqmatic converter with Torqmatic braking, showing simple construction and compact design. This in-the-drive-line unit give off-highway vehicles braking power on downhill hauls.



Allison also offers two versions of hydraulic retarders. In their initial design, the retarder is a part of the converter and is an optional extra that can be field-installed on any Torqmatic Drive not so equipped. It is designed for heavy-duty off-highway hauling and is located between the converter and Torqmatic Transmission.

This arrangement makes it possible to use the capacity of the Torqmatic Brake in each gear range, resulting in maximum flexibility in controlling heavily or lightly-loaded vehicles at maximum safe speeds. The Torqmatic Transmission and drive-line components are protected from overloads by a built-in torque limiter device.

Torqmatic brake is manually operated by either a hand lever or a foot pedal. A valve controls the degree of braking by regulating the amount of oil admitted to the retarder housing. Depending upon the amount of grade and the size of the load, the operator selects the desired transmission ratio and brake valve-setting so as to closely control vehicle speed. By simply opening or closing the brake valve he is able to decrease or increase the truck speed as road conditions vary.

Oil is stored in a reservoir which may be located above or below the transmission sump. It is fed into the retarder by the converter charging pump. When retarding torque is no longer required the driver closes the valve. The retarder impeller pumps the oil back to the reservoir. To insure complete evacuation of the retarder housing, air pressure from the service brake system is used.

The other braking version has been designed into Allison's latest line of Torqmatic Transmissions. Converter, retarder, and transmission are grouped into one complete package, and are engineered for both on and off-highway applications. Method of operation is the same as the converter-retarder combination except the transmission sump serves as the oil reservoir and air scavenging is not required.

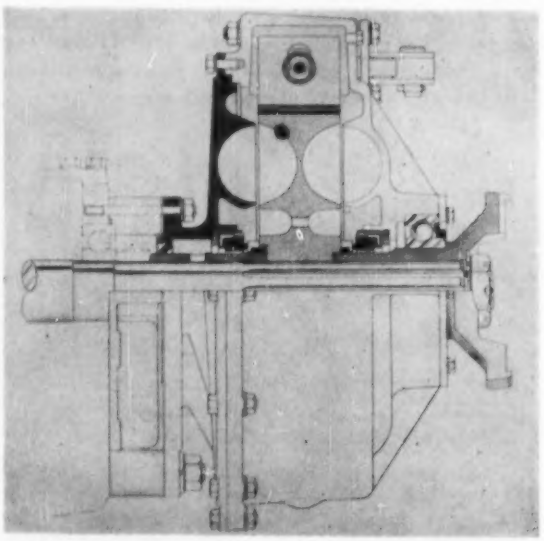
Allison retarders are constructed simply. Both brakes have an impeller, cast grounded vanes, and a control valve. The impeller is attached either to the converter output shaft or to a suitable rotating member in the transmission. It is surrounded by reaction members in the form of cast vanes in front and rear housings. Design is completed by adding a control valve for regulation.

Torqmatic drive-back combinations have been thoroughly field-tested at various locations since 1952. At one of these, torqmatic was installed on some of the trucks at a Utah copper mine. After evaluation against trucks with step-gear transmissions and conventional braking, it was found that the fluid-drive units showed a 50% increase in the number of trips per shift. Trucks with converter-brake units made 21 trips; the others only 14. In addition, brake maintenance and tire replacement was greatly reduced.

Since the retarder worked in conjunction with the Torqmatic drive, it is hard to apportion the percentages of the results that can be attributed to each. Certainly all of the savings in brake maintenance and a good part of the longer tire-life accrue to the retarder, and it certainly helped the drivers to make faster time down-grade.

Similar success has been attained from other type retarders designed for over-the-road use. The Thompson retarder, for example, is really two separate units. There is a hydraulic-type retarder mounted directly behind the transmission, and another mounted on one or more of the axles. This spreads the braking action over a maximum of tire-road contact area.

This rear-axle retarder is splined to a pinion shaft, which operates as a part of the driveline. The stator is cast with the outer housing, and is bolted to the rear axle carrier. The torque reaction is transmitted through the housing to the rear axle housing.



Thompson's double-element transmission-mounted retarder. Rotor has two semi-toroidal cross sections back-to-back. Stators face both sides of the rotor, and together form the housing. Photo—Thompson Products, Inc.

The transmission-mounted version differs in that it is a double-torus unit. The rotor has two semi-toroidal cross-sections back-to-back. The stators face both sides of the rotor and are bolted together to form the housing. This in turn is mounted behind the transmission. The output shaft of the transmission drives the rotor.

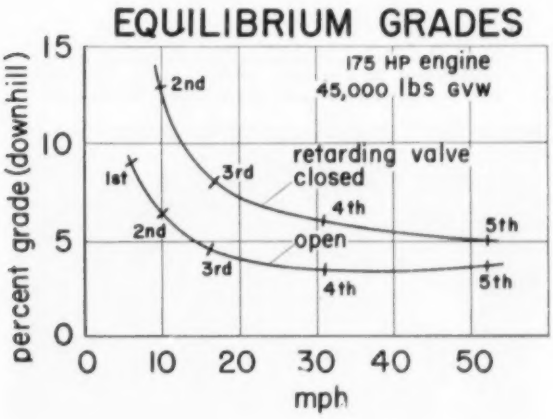
Both the single and the double-torus units are of equal capacity. The outside diameter of the torus on the double-element rotor is 10.6-in. The single-element rotor has an outside diameter of 12.75-in, which increased fluid circuit diameter, providing the same capacity.

Although operating on the fluid principle, hydraulic retarders also use engine compression, transmitted through the oil, to develop part of their retarding torque. Another type of retarder magnifies this compression, and such devices are known as compression retarders.

Compression Retarder

Compression retarding involves a minor addition to the 4-cycle engine, converting it to a compressor when it is being driven by the wheels. This is done by closing off the exhaust manifold by means of a valve or butterfly. Selective retarding effect is then obtainable by simple controls.

This suggests it to be a low-cost method of obtaining auxiliary braking effort. Simplicity is an added virtue. Actual retarding effect will largely depend upon the engine displacement-vehicle weight ratio with the counter-torque increasing with the ratio. An example of effectiveness is given in the "Equilibrium Grades" chart.



The engine's energy-absorbtion capacity follows a fairly constant pattern, varying with engine rpm. Transmission gear-steps then act as counter-torque multipliers. With no retarder and on a 6% grade, second gear must be used to hold a constant speed (10 mph) without brake application or engine overspeeding. With the retarder, fourth gear could be used and about a 31-mph speed maintained.

The effect of blocking the exhaust-manifold is to turn the engine's exhaust-stroke into a compression stroke. The gases in the engine are compressed again on this stroke. Compression ratio is low as the clearance area comprises the combustion chamber and the exhaust manifold up to the valve.

Some of the work of compression, represented as heat, dissipates as the compressed gases expand into the intake manifold during valve overlap periods. Thus part of the work done by the piston is not returned to it. There is another method of escape too.

As exhaust manifold pressure builds up (it will be gradual) it can reach a point where it exceeds the exhaust valve spring tension. Gases can then escape to the intake system when the intake valve is open. Maximum pressure, then, is a function of valve spring tension, since the valve acts as a relief. The higher the manifold pressures, the higher the retarding torque. So high-speed engines, having high spring tensions, will produce relatively higher retarding torque than will low-speed ones.

Retarder valves may be arranged for full or partial closing, depending on the conditions of operation desired. As one example, the retarder valve for a turbocharged engine is placed between the manifold and turbo and adjusted not to close completely so that the turbo does not stop.

Special arrangements are sometimes required. Mechanically-supercharged engines, for example, require a relief valve between the blower and engine to prevent excessive loading of blower and drive. As for 2-cycle engines the whole project becomes rather complicated, sometimes requiring major engine modifications.

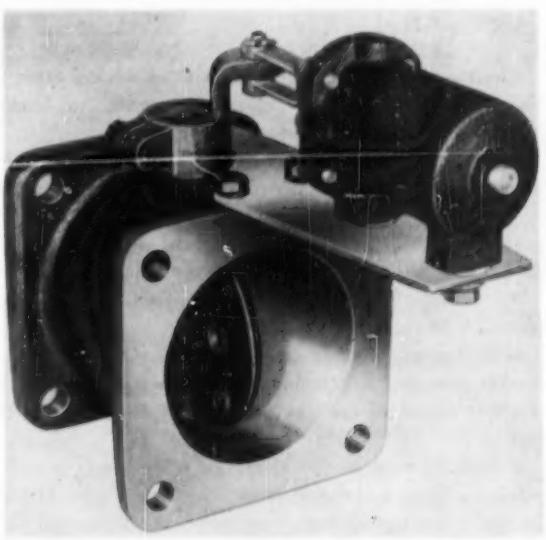
In answer to an obvious question, no, compression retarding is not harmful to the engine. Analysis and experience shows that valve-gear failures do not increase and the heat is not harmful, in fact is beneficial when it is remembered that during long descents over-cooling is the usual problem.

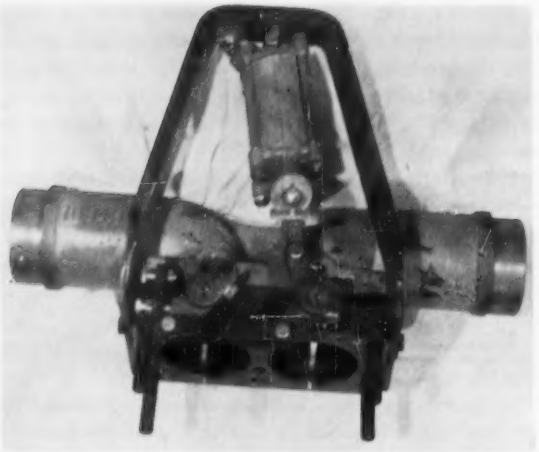
Operating within the basic principle of compression braking, there are variations from which to select the best system for an individual application. One system may close off the exhaust completely—another may let a little escape. One may idle the engine during compression—another may not.

The compression retarder manufactured by Mack Motor Truck Corp., for example, uses a butterfly that may be closed completely. The electro-pneumatic control system operates off a three-position switch within easy reach of the driver.

In the first position, the butterfly will close and compression will begin automatically when brakes are applied. In the second position, the butterfly actuates upon the release of the accelerator. The third position takes the retarder out of action completely.

Butterfly valve from the Mack Truck unit blocks exhaust line for additional compression. Override switch actuated by fuel injection pump allows closing only after injection has ceased. Photo—Mack Truck, Inc.





Williams turbo-compression brake mounted between manifold sections. Superchargers and turbochargers call for special considerations when installing an exhaust-blocking unit. Photo—Power Brake Equip. Co.

When in the first two positions, an override switch is actuated by the fuel injection pump. This switch allows the compression braking mechanism to come into play only after injection has ceased. Thus, nothing but pure air is trapped by the butterfly and compressed.

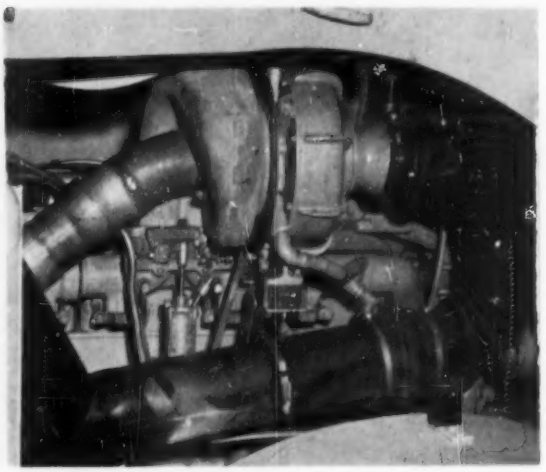
On the other hand, Williams "Compression Brake" (Power Brake Equipment Co.) is fitted with a butterfly valve that has a stop. This prevents the butterfly valve from closing completely when the mechanism is actuated. The stop is adjusted to permit the engine to idle.

The "leak" is a constant-area escape. Its effect is somewhat more noticeable at low speed; but diminishes at the higher ranges.

The retarder butterfly is unsymetrical and so torque is produced on its shaft by the exhaust manifold pressure. This force is balanced by a pneumatic control cylinder, actuated from a dash-mounted control station. A manual valve controls air pressure to the cylinder and hence the positioning of the butterfly. A gauge registers manifold pressure. This makes it possible to control the degree of retarding effect as required.

Another valve is actuated by the accelerator-pedal linkage. Its effect is to open the retarder valve whenever anything more than idle fuel is required, and thus provides for immediate engine response on demand. The combined controls provide for safe up and down-shifting without danger of stalling wh.le also controlling the retarding function.

Compression brakes are simple and require very few engine modifications. Here, Williams turbo-compression brake on a Cummins engine equipped with an Elliott turbocharger.



Electric Retarders

Electric retarders change motion into electrical energy, then into heat. One type uses eddy currents, and here's how it works.

When the coil of the retarder is energized, magnetic lines-of-force are set up. Any conductor cutting these lines produces electrical energy. If a closed circuit rotor does the cutting, the energy is in the form of eddy currents in the rotor.

At the same time, considerable mechanical energy is necessary to cut these lines-of-force.

Thus, the torque required to turn the rotor of the eddy current retarder is translated into braking effort. The resultant electrical energy is dissipated in the form of heat.

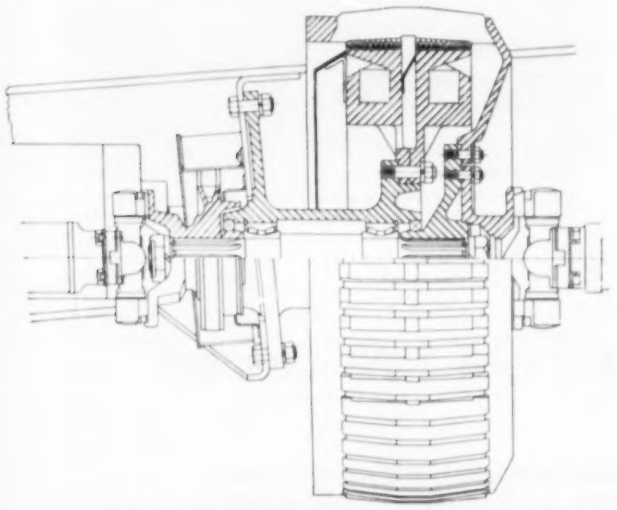
Warner Electric Brake Mfg. Co. makes such a unit, called the Eddy Current Retarder. In their's, curernt for excitation is supplied from a generator-belt driven off the propeller shaft. The heat is dissipated directly from the rotor to the air. Air-scoops along the periphery of the rotor fan air past the generating components and carry the heat off by convection.

Normally, engine speed in direct drive is satisfactory to perform both these functions. This permits a mounting in the drive-line of the tractor. But because of the fly-wheel effect of the rotor, it should not be mounted ahead of a two-speed axle.

A second retarder may be recommended for installation on the wheels of the tractor. It is fitted by means of a geared axle, and the generator is driven off of it through a shaft anchored to the frame.

The Eddy Current Retarder is controlled by two switches; one is mounted on the foot pedal; the other on the brake. When the driver lifts his foot from the accelerator, the retarder cuts in automatically at speeds over

25 to 30-mph. This relatively high speed-range was selected to prevent any difficulty in accelerating normally through the lower gears. The retarder will continue to function down through the lower speeds as long as the driver actuates the pedal switch by application of the brake. It goes out of action at 10 to 12-mph. Brakes can handle a full stop from this speed without any excess wear.



In Eddy Current Retarder, energized coil sets up lines of force. Energy needed to cut these lines of force is retarding torque.
Photo—Warner Electric Brake

This type of control system allows the driver to just "do what comes naturally". If he wishes to slow down, he takes his foot off the accelerator. If this doesn't slow him down fast enough, he goes to the brake pedal. The retarder will than stay with him to the lower speed ranges. If he changes his mind and pushes on the accelerator, the retarder cuts out automatically.

Tests on the Eddy Current retarder under operating conditions have been underway for several years. They show a remarkable increase in service brake life.

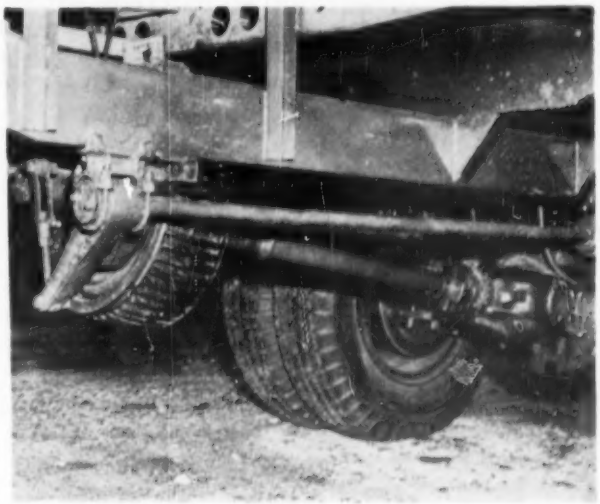
To quote from a paper presented before the Society of Automotive Engineers in 1947, J. G. Oetzel of Warner said of a test unit:

"Inspection of the brakes on the tractor-trailer unit after 2500 miles of service—showed the linings were not yet well seated and the grinder marks were still very plain in the drums. It is difficult to estimate the lining life with any degree of accuracy, but I believe 200,000-mi would be a fairly conservative guess—"

The Electrotarder of LeTourneau-Westinghouse is another type of electrical retarder that applies to their particular equipment. A generator in the drive line is electrically loaded by cutting in a resistance. This increases electrical resistance to generator rotation; hence a resistance to rotation of the drive line.

The horsepower extracted electrically from the driveline is dissipated at the resistance in the form of heat. This unit is of the "one-stop" type, operating on an "on-off" basis. The operator allows the machine to overspeed slightly, puts the retarder in operation, and when speed is reduced slightly below his average, he releases the braking effort.

Axle-mounted eddy current retarder mounted to frame of trailer.



Conclusion

It takes horsepower to pull a heavily loaded vehicle up a hill and it takes horsepower to control its descent. Today's engines can pull them up; but friction brakes fall short of the ideal unless you sacrifice downhill speeds or accept high brake-maintenance costs.

An auxiliary braking system is the obvious answer. It won't replace the service brakes; but it will take over that part of their job that costs you money.

Field tests leave little doubt. Trucks equipped with retarders require less downtime, deliver more trips, and work a lot faster. They're safer too, and cost less to operate.

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Electric Retarders

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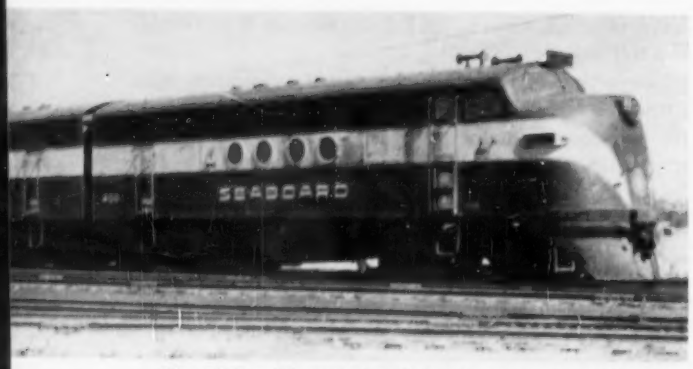


This old FT unit is received at EMD's plant for remanufacture and upgrading. Units "A" and "B" shown are permanently coupled.

This is a GP9, 1750-hp locomotive after being remanufactured and upgraded from one of the two FT units in adjacent photo.

Locomotive Remanufacture—A New Concept

Upgrading of old EMD diesel locomotives by remanufacture gives them new-model capacity, components and warranty. Large savings in railroad operating costs are anticipated although initial cost of remanufacturing is higher than cost of major overhaul and rebuilding in kind.

AMERICAN railroads can save at least $500-million in the next five years. This will be possible through upgrading of older diesel locomotives. Remanufacturing them when they need a major overhaul instead of rebuilding them will do the trick.

This modernization plan and its economic results was presented recently by N. C. Dezendorf, General Manager, Electro-Motive Division, General Motors Corp.

EMD believes that these potential savings can become a reality by capitalizing on the technological advances attained in diesel locomotives in the last 10 to 12 years, if the railroads adopt such a program.

After two years study, EMD engineers have solved the problems of converting early diesel units. Standardized designs have been worked out whereby these units can be economically dismantled, some parts salvaged, others remanufactured, some replaced by newest developments, and the whole made into a modern upgraded locomotive carrying a new unit warranty.

In some cases this will be of an entirely different type than the original. This technique has been developed to the point where many units undergoing remanufacture go straight down the production line with new locomotives.

This procedure must not be confused with "back shop" heavy overhauls of locomotives which some railroads do in their own shops. "This does not require the heavy investment in machinery, methods and skills used by EMD," according to Mr. Dezendorf.

Major Overhaul Needed After 12-15 Years

Diesel units, 12 to 15 years old, are reaching the point, for the first time, when they must get a major overhaul. EMD locomotives were designed for easy replacement of main components such as engines, generators, traction motors, and auxiliaries so as to keep the locomotive on the road with a minimum of down-time.

Replacement cycle for these assemblies is about six years. During the second such cycle, extensive rewiring, reworking of control apparatus, structures, trucks and running gear must be made. This necessitates shopping the complete locomotive.

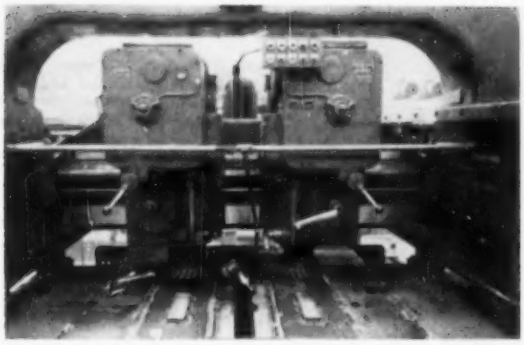
A recent survey shows that of the 18,000 GM locomotive units in service in the U. S., 7,758 will reach their major overhaul period during the next five years.

Modernization Costs and Returns

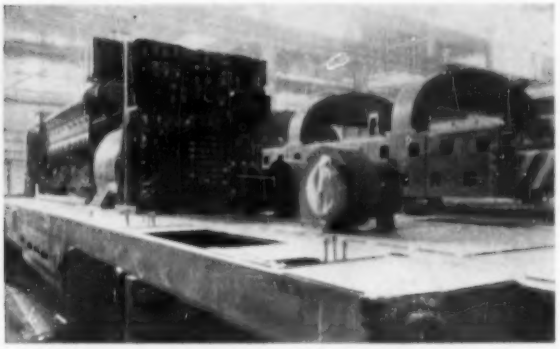
At current costs, about $768-million would be required to remanufacture these locomotives. While part of this amount (cost of merely overhauling) would be chargeable to current expenses, the upgrading creates a capital addition.

Experience indicates that a minimum return of 12.5% of investment cost may be expected from upgrading remanufacture. This return is realized in reduced transportation costs through increased work capacity and in reduced locomotive maintenance costs.

It is estimated that the returns, spread over the next five years by increasing increments as the program pro-



One of world's largest portable milling machines is seen in place on a new underframe to machine equipment-mounting surfaces for the engine, main generator and air compressor.



Installation positions of the engine, main generator, electrical control cabinet and a-c motor-driven traction motor blowers are seen on underframe of GP9 locomotive unit after remanufacture.

gresses and capital investments build up, would total $200-million. Added to this would be the $310-million, that the railroads would have spent to merely rebuild in kind the 7,758 units mentioned. Thus the approximate $500-million addition to earnings is seen possible during the next 5 years.

Program Already Started

While this EMD practice is comparatively new, 173 switching, passenger, and freight locomotives 12 years or more old have already been converted for 15 railroads. Conversion of these units cost $20.5-million, on which these railroads will produce an investment return of $2.6-million per year.

In addition, work is proceeding on firm orders and pending programs covering 285 units. When completed the cost will total about $34-million, on which the investment return will exceed $4.25-million per year.

FT Models—Good Subjects For Upgrading

A case example of an order for upgrading EMD model FT diesels was given M. H. Gardner, Assistant General Sales Manager of EMD.

The FT model introduced in 1941 wac the first main line diesel-electric locomotive in freight service on U. S. railroads. From 1941 to 1945, 1065 of these 1350-hp units were delivered to 23 railroads, and are said to have earned their cost over and again. Many of them have accumulated between 1¼ and 1¾-million miles in heavy freight service but now they require extensive repairs.

To repair these old models in railroad shops so they are as originally built, with the same 1350-hp capacity but with no warranty, would cost about $40,000 to $50,000 each. The EMD plan converts them to modern general purpose GP9 model locomotives rated 1750-hp which will perform exactly as new units and are covered by the same-as-new locomotive warranty.

This conversion cost is approximately $120,000 each. A new GP9 unit costs around $160,000. Optional extra equipment such as multiple unit control, dynamic brakes, steam generators, etc., applicable to either new or converted units, could raise these amounts by as much as $20,000.

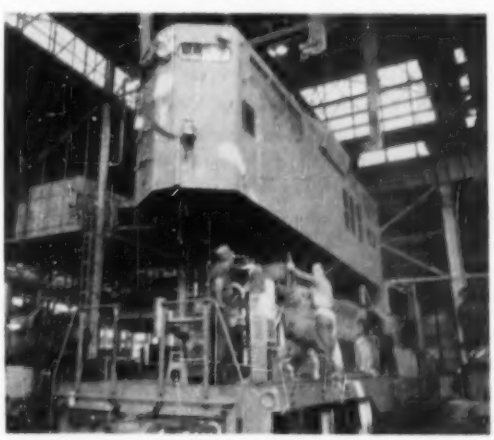
New And Old Components Used

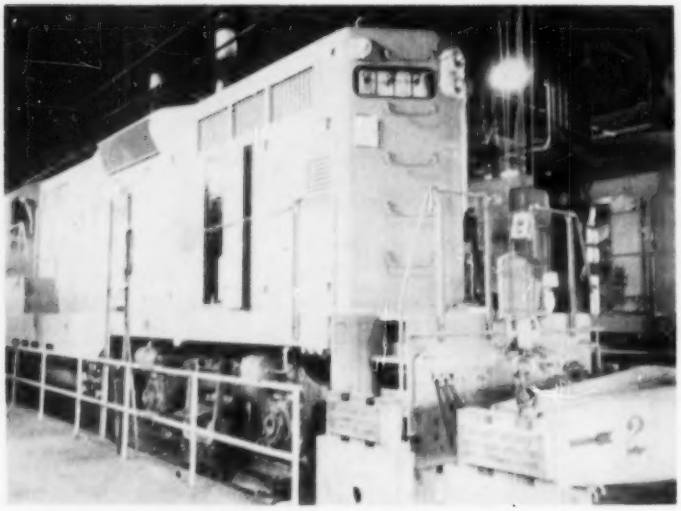
An upgraded locomotive has a large number of new parts. These are improved parts of the latest design.

New components, to mention a few principal ones used, are: a new underframe, of greatly improved design and strength, necessary because of increased capacity of unit; the latest model 16-567C diesel engine rated at 1750-hp (some parts are from old 567 engine in FT model as noted below), with a new higher capacity main generator; a production model electrical control cabinet; and a-c motor-driven traction motor blowers.

Also included will be a new cab assembly with a short hood—having all new equipment such as control stand, air brake, instrument panels, seats, etc. A new engine hood will also be furnished with its self-contained cooling system and dynamic brakes. Other components such as the air compressor, lube oil filter and cooler, water

The new engine hood with its self-contained cooling system and dynamic brake is seen being lowered over the diesel. A new cab assembly with short hood is in place at other end.





This remanufactured locomotive is shown on the test tread mill where it is operated under full load, simulating actual operation. It goes through the same testing and loading procedures as the new production units made at the plant.

tank, and fuel pump, as well as exhaust manifolds will also be new equipment of the latest design.

Parts used from the FT unit are the engine crankshaft; camshafts; engine blowers; oil pumps; water pumps; batteries; voltage regulator; reverser; auxiliary generator; and truck assemblies including the traction motors. All of these parts are reconditioned and modernized by remanufacture incorporating the latest design improvements.

Traction motors are remanufactured and converted to the standards of current D-37 models. This procedure involves a number of principal items—brush holder studs; air baffles; silicon insulated armature coils; improved axle caps and axle-bearing lubrication; D-37 stator coils; and new armature bearings. Improvements since the FT locomotives were built have raised traction motor capacity about 30% with no change in physical dimensions. Complete interchangeability of motors and motor components has been preserved. This was no accident—it is a planned EMD policy.

All remaining equipment and parts are new.

Performance Comparison

The GP9 locomotive can pull the same tonnage 37% faster than the FT. When operated at the same speed, the GP9 will pull 33-1/3% more tonnage than the FT. The added capacity of the GP9 can be used for increased speed, increased tonnage, or a combination of both.

Most railroads operate their FTs in 4-unit locomotives. A tonnage train for a 4-unit FT can be hauled by a 3-unit GP locomotive—or, a 4-unit GP9 locomotive will pull at least 34% more tonnage than a 4-unit FT consist.

Consider the savings possible for a railroad that can operate one-third longer trains. On such a road, a group of 16, FT units necessary to haul four trains can be replaced with 12, GP9 units handling the tonnage in three trains instead of four, thereby reducing train miles 25%.

At an operational cost per train-mile of $1.5204 for a 4-unit FT locomotive, and $1.4478 for a 4-unit GP9—(each operating 120,000-miles per year), the annual savings are: $182,448 for one train eliminated—120,000 train-miles at $1.5204; and $26,136 reduced cost of operating the three longer trains—a difference of 7¼ cents between costs per train-mile for a 4-unit FT and for a 4-unit GP9 for 360,000-miles.

This total of $208,584 saved, is 12.4% on $1,682,000 the investment cost of converting 12 FT units to GP9 model. Fuel costs were ommitted from this calculation, as the quantity of fuel per freight-ton-mile is considered the same for either an FT or a GP9 locomotive. Most of the 7¼ cents per train-mile saving is in the lesser maintenance cost of the GP9 model.

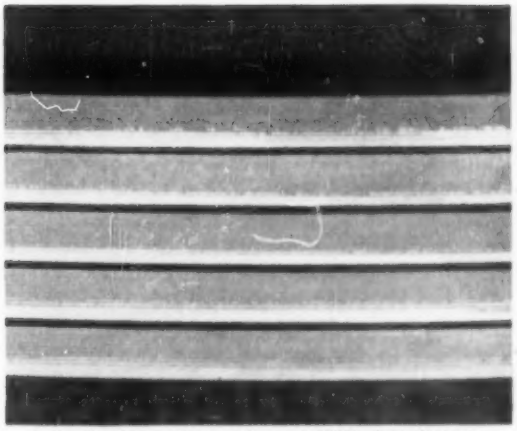
Conclusion

EMD is currently expanding manufacturing facilities 42% at La Grange, Illinois. Part of this expansion is necessitated by development of the ungrading business.

Another important factor however is the belief, (based on the best projected census and economic growth figures available for the U. S. over the next 10 years), that there will be an increase of 40% in rail traffic, both passenger and freight, which will require additional motive power. Already, one-third of EMD's business in 1956 came from railroads whose managements considered themselves completely dieselized from one to three years ago.

Then, there are 3500 steam locomotives still in service on Class I roads of this country yet to be replaced by some 3000 diesel-electric units. This can be done over the next three years at the recent purchasing rate.

Why Chrome-Plated Rings



Prelapping insures fast seating and 100% light tightness.

by Helmuth G. Braendel Director of Engineering and Production. Wilkening Mfg. Co.—Manufacturers of Pedrick Piston Rings.

A layer of chrome over the faces of piston rings reduces wear, makes them work better and last longer, and saves maintenance.

DESPITE all our efforts to improve ring designs and employ better ring materials, we find the piston ring to be still the most expendable part in an engine. This is so since it is subjected to an apparently impossible combination of adverse operating conditions. It must seal very high gas pressures at elevated temperatures at relatively high rubbing velocities, with an infinitesimal consumption of lube oil. It must do this for periods of tens of thousands of hours without suffering in sealing.

Chrome plating was first introduced into high-output and ordnance engines during the war in an effort to reduce ring and cylinder wear. In North Africa, fine and highly-abrasive dust limited the life of an engine to about 50 hours before it was completely worn out. Improving oil-bath air cleaners up to 99% efficiency helped considerably; but engine life was still limited to about 100 or 200 hours—still too short. Chrome plating was tried in desperation as a means of increasing life.

Prior to this, most engineers had deep misgivings about using chrome in this way. The hard chrome surface would reduce ring wear, but it would certainly increase wear on the cylinders. Ring materials had always been relatively soft and porous, and provided a high margin of safety against scuffing under marginal conditions.

Successful Reduction of Wear

The very hard, impervious plating, even though reverse etched ("porous chrome"), represented a complete deviation from accepted practices, but initial results were successful beyond all expectations.

Experimentally, abrasive dust conditions similar to those in the desert were simulated. It was found that using chrome on the face of the top ring increased ring and engine life between 300% and 400% over the identical conditions without a chromed top ring. Using a second chrome-plated ring gave an additional improvement of between 10% and 15%.

Although it was expected that cylinder wear would increase, actually the cylinders, and also the plain cast-iron rings below the top rings, showed a reduction of wear in the order of three to four times. When the tests were repeated under normal clean-air conditions it was found that the wear of rings and cylinders was still reduced in the order of two to three times that of the engine run under the same conditions without chrome top rings.

For some time, the engineers found it difficult to explain the unexpected good performance of chrome-plated rings —especially the reasons why cylinder wear was reduced to such an extent. It was felt that the hard chrome would induce, if anything, higher wear than the soft cast iron rings. The final analysis of this outstanding performance is as follows:

Chrome Reduces Wear Three Ways

Chrome plating the top rings helps reduce all three types of wear occurring in an engine. These are:

Scuff wear is probably the most prevalent type of wear in engines operating under normal conditions at high loadings. It is caused by a temporary failure of the oil film, permitting the surface of the ring and the surface

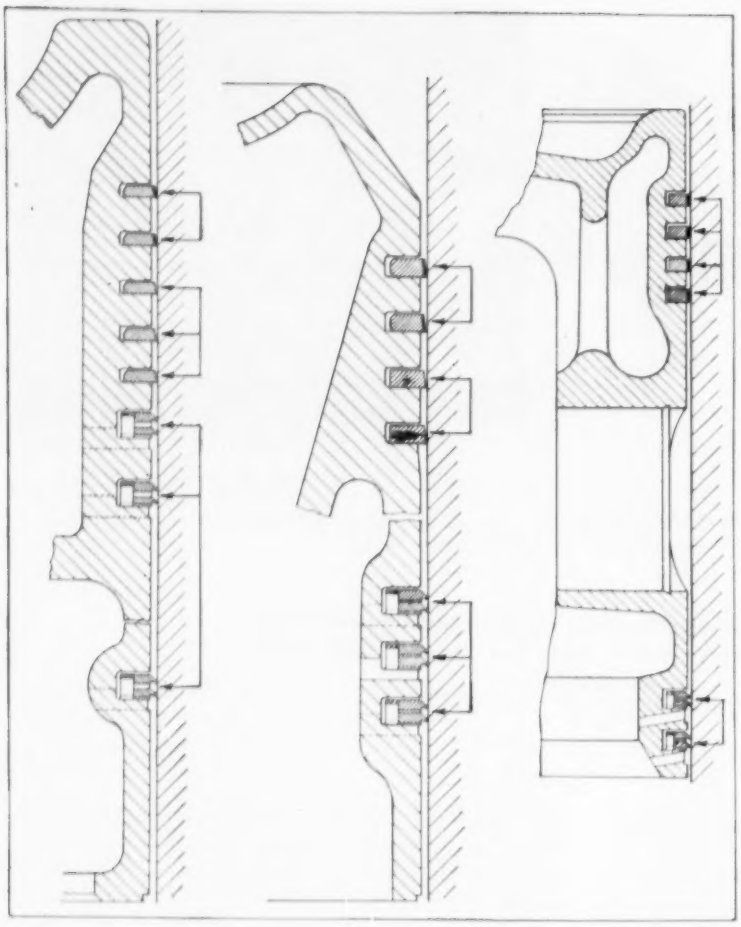


Fig. 1 shows a typical ring installation on a 4-cycle engine. The two top compression rings are chrome plated. The first top or top-two compression rings are almost always chrome-plated on 4-cycle engines unless the liner has been chrome-plated. It's not necessary to plate the other rings.

Fig. 2 shows a large 2-cycle, port-scavenging engine ring installation. This also has the two top compression rings chrome plated but not others.

Fig. 3 shows a section of a GM "71" piston. This small 2-cycle engine piston has all its compression rings chrome-plated, but not the oil rings.

of the cylinder to make metallic contact. The resultant high friction generated raises the two surfaces to the melting temperature, where they actually weld together and are simultaneously pulled apart.

This is what produces the typical vertical lines in both rings and cylinders. In extreme cases this will result in scoring and seizure. The chrome plating on the part of one surface will resist scuffing because of two reasons. Chrome melts at a much higher temperature than iron. It is also a dissimilar metal and, therefore, welds with great difficulty even if brought to the melting temperature. In some production engines chrome plated top rings have been installed for the main purpose of resisting scuffing!

Abrasive wear is the second type. Since chrome plating is extremely hard, it is, of course, evident why it would wear less than the soft cast iron ring surface under dirty or dusty conditions. The reason the cylinders and the rings simultaneously wear less is that the chrome plated surface is extremely hard and impervious. Therefore it lacks imbedability which allows abrasive particles to imbed themselves into the ring surface and lap out the cylinder. Since they find it difficult to imbed, fewer of these particles reach the cast iron rings operating in the lower grooves. Consequently, these rings also wear less when chrome plated rings are employed in the top or top two grooves.

Corrosive wear is third. It is induced by sulphurous and sulphuric acids which are products of combustion from sour or high sulphur content fuels. These mild acids will attack iron much more successfully than a chrome surface.

As a result of these definite advantages, the industry has used chrome plated rings to an ever greater extent in heavy-duty engines. Now, almost without exception, all 4-cycle heavy-duty engines employ a top or two top chrome plated rings, unless chrome-plated cylinders are used. See Fig. 1 for typical 4-cycle engine ring installation.

Chrome Rings in 2-Cycle Engines

Chrome plating has not been used as extensively in 2-cycle engines, probably because when first tried the art of adhering the chrome to the cast iron was not sufficiently developed to prevent occasional chrome bond failure when the rings passed over the ports. During the past two

years we have again employed chrome-plated compression rings in large 2-cycle engines. See Fig. 2. The results so far are not conclusive since they have not been operating for a sufficient number of tens of thousands of hours.

In smaller 2-cycle engines, such as the General Motors 71 Series, all of the compression rings are now chrome plated. Fig. 3. This engine started first with the top chrome ring, then went to the two top chrome rings, and finally ended with all chrome rings as experience indicated its advantages. This was done in spite of the relatively high cost. It is anticipated that chrome-plated rings will be more extensively used in larger diameter 2-cycle engines in the future.

"Porous Chrome" vs. "Solid Chrome"

Initially, all chrome rings were known as "porous chrome" (developed by van der Horst) because it was first felt that the hard chrome surface would have insufficient affinity for lubricating oil. The porous chrome is produced by reverse etching the rings after the chrome plating process is completed. This reverse etching dissolves part of the surface, leaving minute pockets to retain oil. Experiments with rings plated with hard solid chrome disclosed that such rings gave greater uniformity of performance and life, without suffering any greater susceptibility to scuffing. This led most ring manufacturers to supplant porous chrome with the regular hard-chrome process.

In large engines, chrome-plated rings have been restricted generally to compression rings. In the smaller heavy-duty engines and in a number of automotive engines, chrome plating is now being employed very successfully on oil rings as well. One of the next major developments in the large engine field may be the use of chrome-plated oil-control rings. This, of course, would often have to be justified economically.

Some of the comformable-type oil rings now being employed in large engines show extremely little wear for periods of 30,000 hours. These engines generally enjoy better operating conditions with respect to cleanliness than the smaller vehicle engines, and for this reason the use of chrome plating on big engine oil control rings, which increases the cost, generally has not been justified economically.

Seating of Chrome Rings

Some concern has been expressed about seating chrome plated rings, and what steps should be taken to insure fast break-in. Since the chrome plate is exceptionally hard, it will require longer seating time unless a number of precautions are taken. Most of these are performed by the ring manufacturer instead of the engine operator.

If plain compression rings of rectangular section are chrome plated, a serious seating problem results, requiring much longer break-in time. Practically all modern ring designs employ taper-faced and twisted compression rings for 4-cycle engines, and at least taper-faced rings for 2-cycle engines. In both of these only the lower edge of the ring face contacts the cylinder wall initially, promoting exceptionally fast break-in—even when the face is chrome plated. All of the rings recommended by us are of these designs.

To further accelerate initial seating and mating of ring and cylinder, it is desirable to prelap chrome plated rings to the cylinder size. For the past 15 years chrome plated rings for automotive and aircraft engines were prelapped, but the expense to the ring manufacturer for a very large number of lapping sleeves has prevented prelapping of large chrome plated rings. However, during this year we have started to furnish all popular, large, chrome-plated rings prelapped to insure very fast seating, as well as 100% light tightness. With the taper-faced and taper-twisted designs, and with lapped-chrome faces, it is not necessary to lengthen the running-in periods of engines equipped with chrome-plated rings.

Break in Procedures

There is some dispute regarding the best method of cylinder surface preparation when reringing an engine. Our recommended procedure is to break the glaze with a cylinder hone or glaze breaker, using a stone of 80 to 120-grit size. A cross-hatched hone pattern should be produced with an intersecting angle of the scratch marks of at least 30 degrees. This can be done by moving the hone or glaze breaker with a rapid, oscillating, axial motion as the hone rotates.

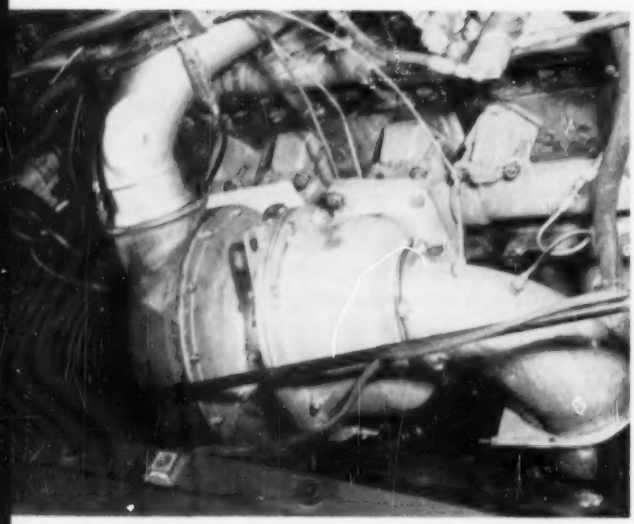
Honing should be accomplished wet, allowing the honing stones to cut themselves free by the time the operation is completed. This will produce a roughness of between 30 and 50 R.M.S.

After honing or glaze breaking, it is *absolutely necessary* to wash the cylinders with soap, water, and a stiff brush to remove all traces of abrasive particles from the porous cast-iron cylinder surface. Otherwise, these abrasives will wear out both rings and cylinders during engine operation.

There are some who do not recommend breaking the cylinder glaze because they fear some engine repair mechanic just won't take the time to do a thorough cleaning job after he has finished. According to this viewpoint, it is better to put new rings into glazed cylinders, and take much longer seating time and risk some initial blowby, than to take the chance that cleaning will be thorough. Taper-faced and taper-faced-twisted chrome-plated ring designs, with their quick seating features, work very satisfactorily in glazed cylinders, but a somewhat longer engine break-in period is recommended. The engine should be carefully checked for blowby during the initial period.

Conclusion

The drive for longer life, better oil control, and better blowby control, insuring cleaner lube oil, requiring fewer filter changes, goes on without abatement. Chrome plating of the compression rings has made ring life of 30,000 to 40,000 hours possible. If this high demand becomes a standard, we will use more chrome-plated compression rings and probably plate the oil rings as well.



When exhaust manifold is of sectioned type, only the center section is replaced for mounting the turbine inlet flange.

Modernizing Your Diesel with a Turbocharger Kit

by Hans Ziebarth, Staff Engineer, AiResearch Industrial Division, The Garrett Corporation

Additional considerations for planning kit-type application of turbochargers to diesels. You must know and observe all the angles for effective conversion.

Part II—Discussing installation, maintenance and costs.

TO make a turbocharger kit installation a success, certain ground rules should be observed.

Let's consider gas flow first. As a rule-of-thumb, about a third of the Btu input to the engine is converted to useful shaft power, a third of the heat is rejected to the cooling water, and the remaining third is normally waste energy in the exhaust gas. Thus the turbocharger has available roughly the same percentage of Btu input to the engine as is converted by the engine into shaft power.

Utilization of this exhaust energy takes place in a space not larger than required by an average-size air filter. This makes it easier to visualize that the flow of exhaust gas through the turbine and of combustion air through the compressor must take place in a highly organized way. This is necessary for efficient energy exchange from exhaust gas to combustion air.

In view of this, a turbocharger's best performance can only be obtained if the "external" flow processes take place in a similarly smooth and well-ordered manner. "External" flow refers to processes of a transitional character taking place in the intake, delivery and exhaust ducts, especially in the immediate vicinity of the turbocharger.

Every designer worth his salt takes considerable pains in laying out an inlet manifolding system for a new engine. The turbocharger duct system deserves the same treatment. If this philosophy is followed, chances of a pitfall in making a "retro-fit" turbocharger installation are already minimized. It will be well worthwhile to bear this in mind during all phases of installation.

Where Do I Put It?

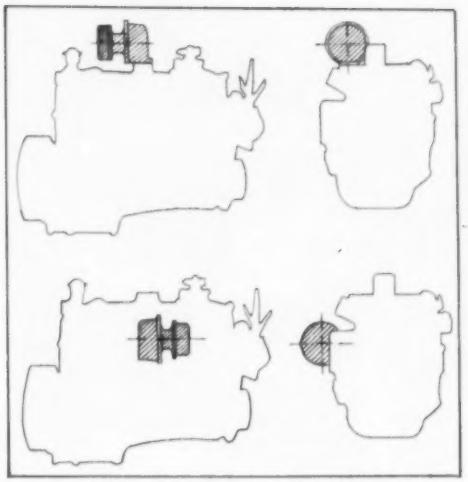
One of the first questions likely to be asked by the diesel operator considering a kit conversion will be, "How will the turbocharger and ductwork fit into my already too-crowded installation?" Fortunately, turbochargers are relatively small and there is flexibility in their location but earlier comments regarding gas flow must be remembered.

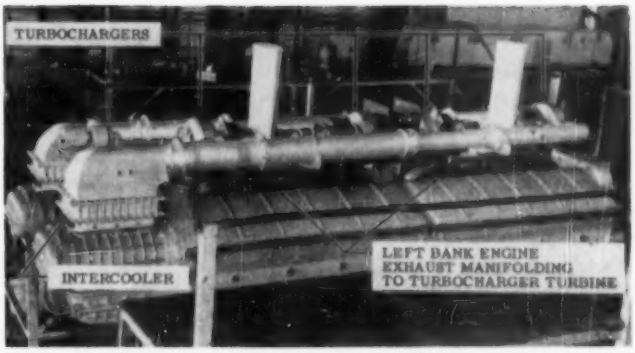
Considering relative sizes of engine and turbocharger, this ratio may be somewhat different for 4-cycle versus 2-cycle engines. For the same displacement and rpm, 2-cycle engines may require up to three times more air than 4-cycle engines. However, the inherent design flexibility of radial compressors is such that three times the flow can be obtained by an increase of wheel diameter not greater than about 25%.

Whether this increase would be reflected in overall diametral space requirements of a turbocharger depends entirely upon its design. If during design, emphasis was on small size, most of the wheel diameter increase would be reflected proportionally in overall diameter. However, turbochargers designed with ruggedness and low cost as primary objectives may allow doubling or tripling of capacity without increase of overall dimensions.

Comparative engine and turbocharger sizes for a typical vehicular 4-cycle engine are illustrated (Fig. 2) along with different mounting methods. For larger engines, use of two or more small turbochargers instead of a single large unit may be desirable where space is a problem.

Such a multi-turbocharger and intercooler conversion installation on a 1750-hp, 2-cycle locomotive diesel is shown (Fig. 3). This specific conversion provided the engine with 30% more air as found necessary for high-





Where space is a problem two or more small turbochargers are used instead of single large unit. This 1750-hp, 2-cycle locomotive diesel has four of them.

Comparative engine and turbocharger sizes for a typical vehicular 4-cycle engine are illustrated along with different mounting methods.

elevation, high-ambient temperature operation. At these critical conditions, a 17% increase in horsepower accompanied by a 10% reduction in specific fuel consumption was achieved.

With respect to size, the turbocharger might be categorized as a mere engine accessory. Actually, being the lung of the modernized diesel, it is a major engine component. Its benefits will repay the efforts of careful planning and, where necessary, rearrangement of accessory items to permit proper installation.

In Part I of this article we saw that, weight-wise, conversions for power boosts of from 40% to 60% need not result in engine overall weight increases greater than 5%. Such power increases with such relatively low space and weight penalties accrue to the credit of the undeterred protagonists of automotive-type turbocharging.

About Hardware

Let's look at the hardware requirements for kit conversion of a standard 4-cycle truck diesel. Those for other types of engines would be quite similar.

1. *Turbocharger*—For most in-line and small vee-type engines the turbocharger will have a single turbine inlet and compressor discharge. For larger vee-type engines, turbochargers with double turbine inlets and compressor outlets to accommodate each cylinder bank separately are being marketed.

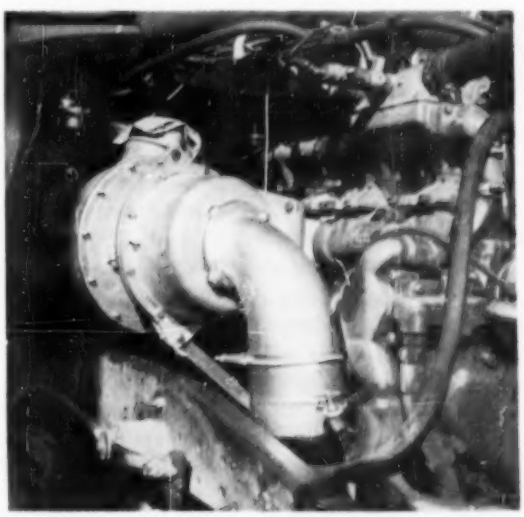
Turbochargers with single turbine inlets may have subdivided turbine housings to avoid harmful interaction of exhaust pulsations and scavenging periods. In this case there are two separate openings in the single turbine inlet flange to fit a "split" exhaust manifold serving, for instance, three adjoining cylinders of a 6-cyl in-line engine.

2. *Exhaust Manifold*—In all cases where the exhaust manifold is of the sectioned type, only the center section has to be replaced. A new center section for mounting the turbine inlet flange is substituted. (Fig. 1) For side installations, an additional support toward the engine flank may be found necessary. (Fig. 4)

3. *Turbine Discharge Duct*—This is a critical part of any kit conversion. Abrupt bends or small size of this duct results in back-pressure on the turbine. Even if relatively small it upsets turbine performance and produces a disproportionately greater increase of engine back-pressure.

A reported case concerning a gasoline engine illustrates this. With an appropriately enlarged turbine exhaust duct, engine back-pressure was 3.5 psig with turbine back

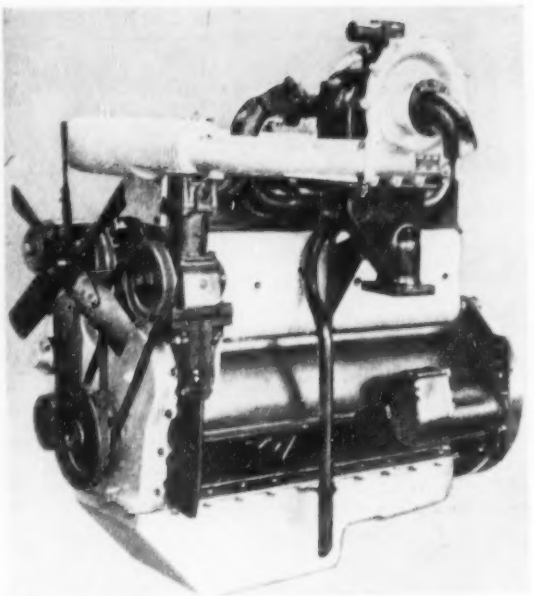
For side turbocharger installations, an additional support toward the engine flank is generally used. Note how the turbine discharge duct is designed to minimize back pressure.



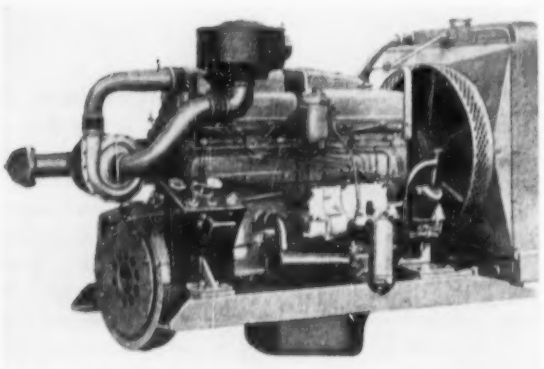
pressure being in the order of below 0.25 psig. Using the standard exhaust pipe and muffler, engine back-pressure went up to 6.5 psig with subsequent failure of the exhaust valves by thermal overload.

Though somewhat drastic, this example is nevertheless applicable also to turbocharger conversions of work-horse diesels. Experience shows that nearly all benefits of conversion can be wiped out if the turbine is "strangled" by back-pressure.

Therefore, duct size downstream from the turbine should be such that back-pressure at the turbine outlet for all practical purposes is equal to atmospheric pressure. In many cases the muffler can be omitted since the reduction of exhaust gas energy in the turbocharger results in a high degree of sound attenuation. It would then only be necessary to substitute an exhaust pipe of increased diameter.



To minimize inflow of heat from hot engine parts to the air, a finned-inlet air duct is cooled by the air from the engine fan.



This stationary diesel conversion has air duct from scroll-type compressor to inlet manifold designed to decelerate air velocity.

For example, in the case of a 200-hp truck engine boosted by 40%, it was found necessary to double the exhaust pipe diameter to obtain this result. No difficulty was encountered in accommodating this larger pipe.

A turbine exhaust transition duct of adequate size and of a configuration conducive to obtaining zero turbine-back-pressure is shown (Fig. 4). Being so critical a component, it would be well to include the duct as a part of the kit.

4. *Air Intake System*—Comments with regard to pressures in the turbine exhaust duct also apply to the air intake ducting and air filter. The object is to avoid restriction to flow. Assume a turbocharger designed to operate with a pressure ratio as close to 2:1 as necessary to obtain a 50% increase in charge air density or power. Then, if the pressure loss in the air intake system were in the order of 0.75 psig, a 5% reduction in power boost would result.

5. *Pressure Air Duct*—Configuration and size of the air duct between compressor outlet and the inlet manifold must also be such as to minimize flow losses. For turbochargers with scroll-type compressor housing, air leaving the housing still has considerable velocity. The air pressure duct, for at least some distance beyond the housing outlet, should have a configuration that would allow the air to decelerate. Fig. 5 shows how this was done fairly well.

When locating the turbocharger and pressure air duct, attention should be given to minimizing the inflow of heat to the system by conduction or radiation from hot engine parts. Any increase of charge air temperature will decrease its density and reduce the effectiveness of turbocharging.

Sometimes it may even be feasible to obtain some charge air cooling between the turbocharger and inlet manifold by rather simple means. Fig. 6 shows a commendable, even if somewhat rudimentary, effort in this direction.

As a general rule, all duct work should contain flexible joints to prevent any duct forces being transferred to the turbocharger housing. For open installations such as on tractors and outdoor stationary engines, the turbine exhaust duct can often discharge freely into a stack of larger diameter in ejector fashion.

6. *Lubrication and Cooling Provisions*—Most turbochargers do not have a self-contained lubrication system. Connections to the engine lubricant circuit, for example in the form of flexible hoses, must be provided. For engine

systems without full-flow lube filtration, installation of a special full-flow filter in the pressure line to the turbo is good practice.

Oil flow through a turbocharger is a negligible percentage of the oil flow through the engine. In a 200-hp engine for example, it would be only a small fraction of 1 gpm. Thus the turbocharger itself will not result in any appreciable heat input to the engine's lube oil system.

Detailed instructions with regard to the size of the turbocharger oil supply and drain lines will be found in most installation directives. Special attention should, however, always be given to ample dimensioning of the oil return line and to utilization of gravity effects. Generally, turbochargers are designed such that engine oil pressure can be used. In most cases there is no need for any pressure regulating or limiting devices.

Some turbochargers require connections to the engine's cooling water system also. In other designs sufficient bearing cooling is provided by lubricant flow. Independence of the engine cooling system can be of advantage in specific adverse operational conditions under which engine cooling requirements approach the system's capacity limits.

7. *Controls*—A turbocharger adapts itself freely to varying engine loads and speeds. Generally speaking, there is no need for controls once the best turbine nozzle ring for certain horsepower characteristics has been selected and installed.

Limit controls for turbocharger speed may become necessary under certain conditions. Such a case might be where a relatively small nozzle ring was installed to obtain exceptionally good engine torque characteristics at part speeds and then subsequently the engine was operated over a wide range of elevations. A relatively simple turbine speed-limiting control consists of a gas blowoff valve between the exhaust manifold and turbine inlet. Fuel rack travel stops would be an alternative.

Controls built into the turbocharger, such as a variable nozzle ring, will undoubtedly be developed and accepted in the near future, despite design complication. Such controls will allow fullest utilization of inherent turbocharger capabilities for widely changing engine operating conditions. Furthermore, by concentrating design "complication" in the turbocharger rather than spreading it over the system, over all maintenance, service and installational problems will be reduced.

Maintenance

Maintenance aspects of "retro-fit" installations are of vital importance, engine overhaul periods, for instance in the trucking field, may be 150,000 miles or longer. At a 30-mph average speed this corresponds roughly to 5000 hours. Anyone contemplating a "retro-fit" installation would like to assure himself of at least an equal period of troublefree turbocharger operation. For locomotive and stationary applications, service in the order of 10,000 hours may be specified.

At first glance this would appear to be asking too much of a machine as highly bred as a modern turbocharger. Those in other fields often do not realize that in commercial air transportation we are living very comfortably and safely with turbochargers and many other types of high-speed turbomachinery. These have to—and do—come up to reliability standards equally high and often higher than would be required from turbochargers installed on diesels.

In discussing attainable life a distinction should be made between turbocharger types that take advantage of rather liberal space and weight limitations and small high-speed units. Most in the first category represent high initial cost, tailor-made, stationary machinery with corresponding very high life expectation. The second type often represents mass-production items of low cost for which life expectancy should be reasonably reduced.

The first type will be excluded from this discussion as kit-type conversions on a large scale will involve turbochargers of the second category. In discussing maintenance requirements, inspection and overhaul periods should be considered separately.

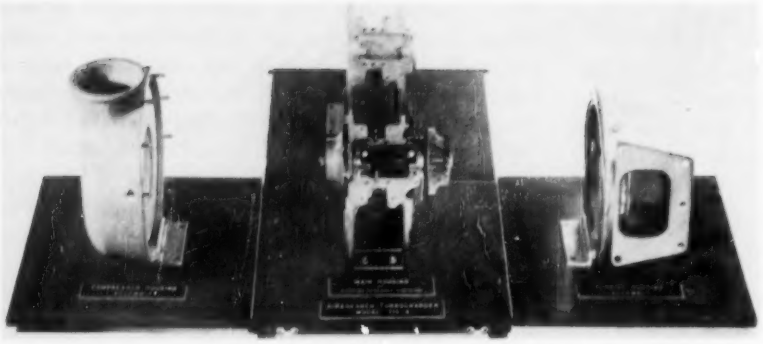
Inspections—Periodic inspections can safely be said to be necessary only for cleaning purposes. Considerable accumulations of dust or smudge particles will build up in the compressor flow passages, particularly when operation is in an environment heavily contaminated by dust. Such is the case with most off-highway equipment.

The length of inspection periods therefore, will then largely be determined by the effectiveness of the air cleaner and its maintenance. Cleaning of high-speed impellers has to be done in a thorough and regular manner since partial or irregular dirt removal may result in rotor unbalance. During dirt buildup, thanks to the regularity of flow conditions in the impeller, accretion takes place in a surprisingly regular pattern.

Overhaul Periods—While inspection periods vary with type of operation, overhaul periods reflect to a high degree the state of the turbocharger design art as represented by a specific make. Since some smaller type units are known to have operated without maintenance for 15,000 hours of continuous operation at sustained load, it appears that the 5,000 to 10,000 periods as applicable to most utility diesels can definitely be met.

After periods of this length, rotating parts only should need attention. In case of operation with dirt-contaminated lubricants, replacement may be necessary. This makes it highly desirable to minimize the disassembly of other components during servicing. Some designs (see Fig. 7) allow such overhaul by replacement of the rotating group inclusive of shaft bearings, a rapid procedure possible in the field with a minimum of special tools.

Should engine parts fail, resulting damage to the turbocharger will be limited to the turbine side only. Valve fragments may pass through the exhaust collector and enter the turbine. Damage generally involves both turbine wheel and nozzle ring. For maintaining tightly scheduled operations, fast installation of a new rotating assembly and nozzle ring is highly desirable.



To minimize disassembly during servicing of turbocharger, some designs can have the complete rotating unit, including shaft bearings, quickly replaced as a unit.

The nozzle ring (2) is clamped to the inner face of the turbine housing (1) by three bolts and can be removed easily.

A simple nozzle ring installation is shown in Fig. 8. It is clamped to the inner face of the turbine housing by three bolts. For access, the turbine housing can be removed easily. Such a design feature is also very convenient for nozzle ring changes to suit changed operational requirements and conditions.

Costs and Kit Items

A comparison of costs between "retro-fit" conversion engines and originally turbocharged engines of equivalent performance will, in a large number of cases, favor the kit conversion. Considerable savings are possible. The reason is that prices of originally turbocharged engines, in general, do not reflect turbocharger and installational cost in a manner comparable to practices in applying special engine accessories.

This situation may change somewhat in the foreseeable future in favor of the originally turbocharged engine. Turbocharging a normally-aspirated model will no longer involve the same extensive development as in the past but be only a matter of routine procedure. This reasoning, of course, only applies to engines which allow turbocharging without major engine modifications.

Turbocharger kits as presently marketed by engine manufacturers generally include the turbocharger and only those items needed for connection to the engine proper. Such parts are: Exhaust collector adapter; pressure air duct; oil and water connections; and miscellaneous seals, plugs and support brackets. Sometimes, engine parts such as special high-temperature exhaust valves, are included.

This practice leaves a somewhat dangerous gap with regard to compressor inlet and turbine exhaust ducting and other critical parts of the installation. The full success of "retro-fit" conversion frequently depend on these items.

Such kits could very well be made to include these transition pieces. This would provide some guidance for the shop making the conversion in providing amply dimensioned duct work for best efficiency. In this way, the conversion would conform to and skillfully exploit the basic natural laws so painstakingly observed in the design of every good turbocharger.

What Do You Know!

Here are some questions to test your general knowledge of the diesel field. Make your selections, then turn to Page 79 to check them.

1. In operation of heavy vehicles up and down substantial grades, one of today's problems is:
   a. Getting enough power to climb.
   b. Increasing climbing speeds.
   c. Getting safe, controlled descent at higher average speeds.

2. Diesels provide less braking action than gasoline engines because their intake manifolds are not restricted by a butterfly as in gasoline engines. A butterfly in the diesel exhaust manifold will increase its braking effect.
   a. True b. False

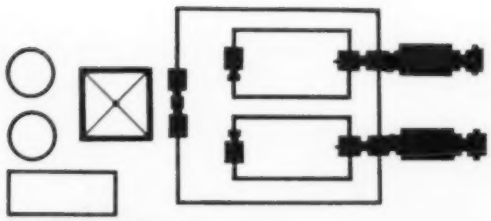
3. One reason that chrome-plated rings reduce liner wear is:
   a. Their hardness.
   b. Their surface smoothness.
   c. Their ability to retain oil.

4. Roughly what percentage of the total Btu input to an engine is available to the turbocharger for conversion into work for intake air compression?
   a. 20%. c. 40%.
   b. 30%. d. 50%.

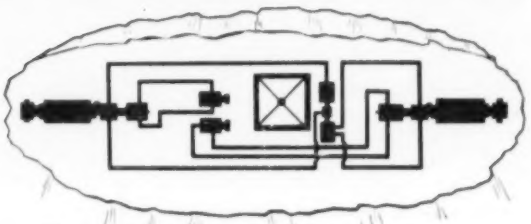
5. Since a turbocharger builds up exhaust manifold back pressure anyway, the restriction to gas flow in the outlet piping is not critical.
   a. True b. False

6. Many turbochargers are lubricated from the engine lube oil system. The amount of heat added to the oil by the turbo itself is:
   a. Negligible.
   b. Moderate.
   c. Severe.

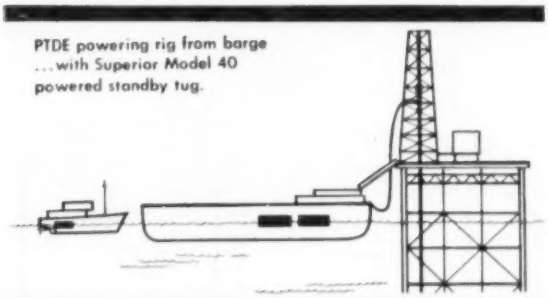
7. If a shovel powered by a diesel through a torque converter hits an excessive load, converter output shaft speed goes down, and torque builds up until engine stalls.
   a. True b. False



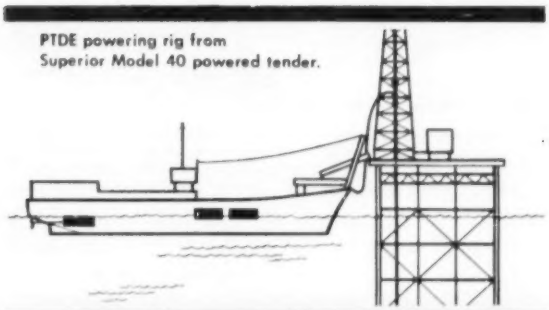
PTDE Basic arrangement.



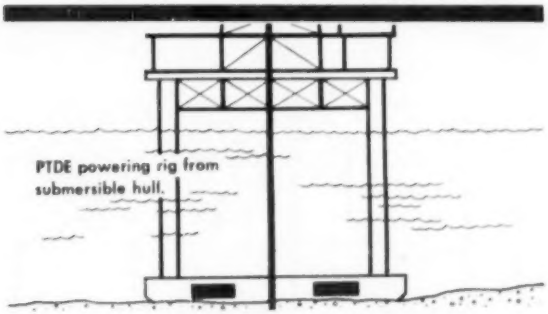
PTDE arrangement for irregular site.



PTDE powering rig from barge ...with Superior Model 40 powered standby tug.



PTDE powering rig from Superior Model 40 powered tender.



PTDE powering rig from submersible hull.

Extreme versatility of installation is demonstrated in the variety of power-plant locations. Irregular sites offer no obstacle, and rig may even be installed on a barge or tender.

White's Diesel-Electric Drilling Rig

Rugged skid-mounted power package provides flexibility to operation and location. Less space and weight requirements aid mobility.

A LOW-WEIGHT diesel-electric drilling rig power package has been introduced by White Diesel Engine Division, White Motor Company. A single set weighs approximately 21-ton, claimed to be about 8-ton less than comparable units. The package is designed for both offshore and inland drilling to depths of over 20,000-ft.

Two sizes are available, the PTDE-8, powered by an 8-cyl Superior engine, and the PTDE-6, with a 6-cyl version of the same basic engine. Both engines are turbocharged, and are available for diesel, gas, or dual-fuel operation. Additional data are contained in the specifications.

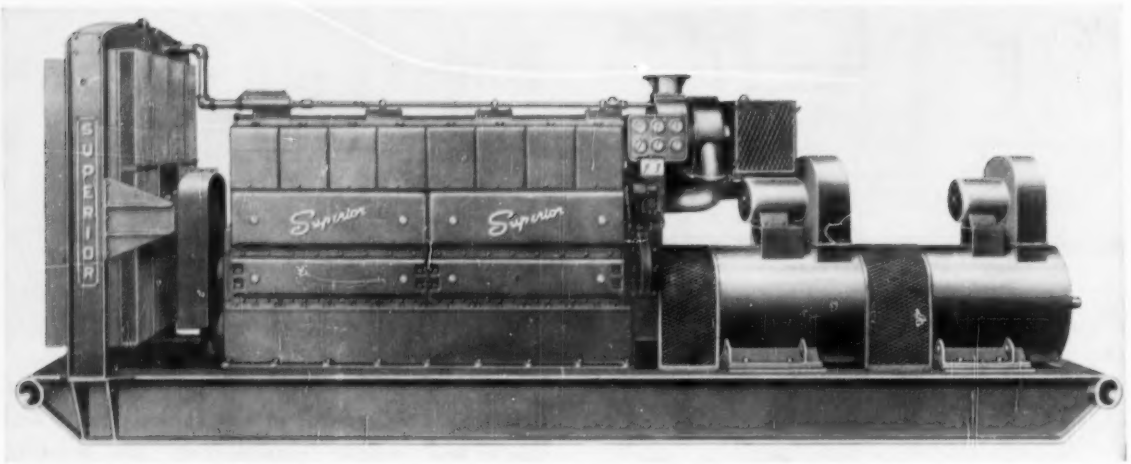
The entire package consists of two or more engine generator sets, a minimum of three drive motors for the drawworks and two mud pumps, a console-type control stand, and a terminal cabinet to house the electrical equipment. Each engine generator set has a Superior engine and two generators.

These generators are Westinghouse 550-kw direct-current generators, driven directly from the engine output shaft. This arrangement eliminates the need for gears and clutches. They are mounted in tandem on the same skid as the engine, and are aligned at the factory.

Along with simplicity of construction, there is also simplicity of operation. These packages have as few as three drive motors, compared to as many as six in comparable units. This is possible because each of the motors is rated 1000-hp continuous, with an intermittant rating of 1250-hp.

These motors are heavy-duty, 6-pole construction, made by Westinghouse in the same basic design as the generators. Because of this basic similarity, many parts may be interchanged between the motors and the generators.

Aside from these advantages, there is the factor of locational flexibility. A diesel-electric set may be located anywhere in proximity to the derrick or drilling floor, as there is no transmission of mechanical power. This flexi-

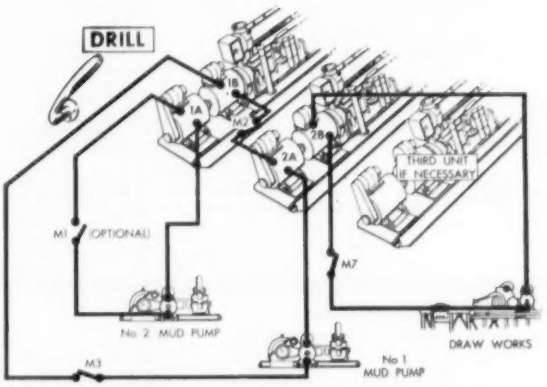


Profile of White's Superior engine-generator set, showing two main generators coupled to the engine, mounted in tandem.

bility is also true of mud pump location. Some possible arrangements are shown.

The driller controls the whole operation from a console located near the drawworks. He determines the power and speed of the units, as well as selection of the generators. Examination of the diagram shows a few of the possible combinations.

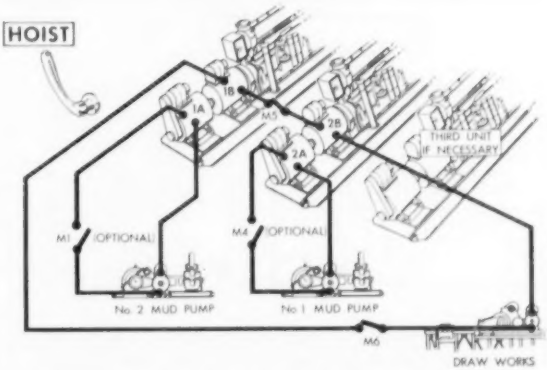
Costwise, every effort was made to keep the initial price low without sacrificing quality. White claims that these sets "explode the belief that the cost of diesel-electric drilling rig power plants is prohibitive. Cost has been held competitive by using standard production units such as our Superior engines and Westinghouse's sturdy motors and generators."



When two engine-generator sets are used, a generator of one is normally connected in series with a generator of the second to power one mud pump. Drawworks is powered by third generator, while fourth generator powers a second mud pump.

Specification chart, showing data on both the PTDE-8, and the smaller PTDE-6. Note the specs on both units are very similar.

SPECIFICATIONS	PTDE-8	PTDE-6
Rated Horsepower	675*	600*
Cycles	4	4
Bore	8½"	8½"
Stroke	10¾"	10¾"
Revolutions per minute at rated power	1000	1000
Idling revolutions per minute	550	550
Number of Cylinders, vertical, in-line	8	8
Total Displacement—Cu. In. (565.8/cyl.)	3575	4767
Brake Mean Effective Pressure-lbs. per sq. inch	150	150
Supercharged (Exhaust-Driven Turbocharger)	yes	yes
Number Crankshaft Main Bearings	5	5
Diameter	6"	6"
Length of shell (except flywheel end)	3½"	3⅜"
Length of shell—flywheel end	4½"	4⅜"
Number crankpin Bearings	6	8
Diameter	5⅛"	5⅛"
Length of shell	3⅜"	3⅜"
Number Camshaft Bearings	7	9
Piston Pin Bearing Diameter	3⅛"	3⅛"
Length	3⅜"	3⅜"
Piston Length	12 15/16"	12 15/16"
Piston Cooling	Forced Oil	Forced Oil
Injection System—Individual Pumps	Scintilla**	Scintilla**
Water Circulating Pump	Centrifugal	Centrifugal
Gallons per minute—full speed	205	205
Lubricating Oil Pump	Rotary Gear	Rotary Gear
Gallons per minute—full speed	105	105
Governor	Woodward	Woodward
Dry Weight (excluding gen. & coupling)	15100 lbs.	13410 lbs.
Rotation (facing flywheel)	Counter clockwise	
System Supplies		
Lube oil in System, Gals.	100	110
Water in System, Gals.	120	140



Generators in series are used for the drawworks, while a generator still is available for each mud pump. This flexible arrangement of power makes possible maximum application of power to the operation requiring it under any load condition.

The torque converter seen through the open door at the rear corner of the turntable transmits power from the 500-hp diesel to the 5½-yd Lima 2400 shovel having a 52-ft boom, and 45-ft dipper stick. This shovel weighs about 500,000-lb.

Torque Converter Boosts Shovel Performance

Output up, shock loads down. This means more work at less cost. Smoother, better performance sparks trend to torque converter drive.

"POWER shovels without torque converters will be obsolete within a few years." These are the words of an expert in this field, W. M. Phillips, vice president of the G. C. Phillips Tractor Co., Inc., a representative of 20 major manufacturers of road building and contractors' equipment. He bases this opinion on the fact that of the 15 shovels that his company sold last year, 14 were equipped with torque converters. And this appears to be the trend throughout the industry.

That this trend is here to stay and not just an overnight affair is confirmed by the many benefits received when a shovel is torque-converter equipped. Shovel operation is made easier, maintenance is reduced and production rate is increased. It has a greater bail pull at any given speed than an equivalent mechanical-drive machine. And its maximum operating speed is always higher.

According to Mr. Phillips, the big problem with power shovels driven through other types of transmission has been the kinetic energy or flywheel effect of the engine's rotating parts. These produce shock loads on the drive mechanism when the shovel dipper strikes an immovable object. Engine stalling, snapped cables and fatigued gears are the results. These in turn result in high maintenance costs, more down time and less production.

With a torque converter, any loss in line speed when the dipper is restrained by increased load causes an increase in line pull. Engine speed increases automatically producing more power and torque is multiplied automatically to increase bail pull and handle the greater load. It's almost impossible to transmit kinetic energy forces to the rest of the machine if the bucket stalls suddenly.

In the contractor's language, this means that the dipper may be stopped for a moment by some heavy object on the ground—but instead of stalling the engine or jerking and pawing at the earth, the shovel steadily increases its power, easing through the material blocking the dipper.

If a rock is immovable, the shovel builds up to its maximum governed engine speed and the torque converter output shaft builds up a maximum torque. These conditions hold until the operator releases the dipper to try another attack. Thus, in spite of any immovable object, the engine continues running instead of stalling and shock loading is reduced considerably.

Let's see how this works in practice. The shovel is a 5½-yd, 500-hp diesel-powered Lima 2400—the torque converter is a National single-stage type made by the National Supply Co. This torque converter is time proven, it has been successfully used in heavy-duty operation on oil well drilling rigs for the last three years. Now, being aware of all the benefits of torque converter use in shovels, and the potential market in this field, National Supply has made their unit available for this application.

The diesel has a high idle speed of 1340-rpm and a tail shaft speed (after the torque converter) of 850-rpm. Max-

Use of this National torque converter in the Lima 2400 shovel has greatly reduced strains resulting from removing rocky overburden.

imum normal speed setting for most shovels is 1200-rpm, at which the converter stops building up torque. As speed drops during engine operation, torque performance efficiency is generally lowered. But the National converter's maximum efficiency is said to be maintained under extremely difficult conditions.

For example, the new shovel has been used during the past several months to uncover a coal vein over which there are 30 to 35-ft of overburden. In this overburden is a 12 to 14-ft layer of solid blue granite sandstone from which rocks up to 25 tons or more are produced by blasting. The Drummond Coal Co., owners of the shovel, say that despite these conditions they maintain steady production with no engine stalling and minimum maintenance costs.

Present daily coal production is 400 to 500-ton of bituminous coal per 16-hr day. The daily removal rate of 1000 to 1500-yd with the 2½-yd, mechanically-driven shovel formally used has been more than doubled to 2500 to 4000-yd.

Although the most important operation powered on this shovel is digging, the following are also performed through the torque converter: closing the dipper door; hoisting and lowering boom hoist; raising and lowering dipper hoist; advancing and retracting dipper; crowding dipper; swing the whole unit around; and driving the travel mechanism for overland movement.

Grid blasting journal before metallizing.

Rotating crankshaft being metallized

New Process for Reclaiming Crankshafts

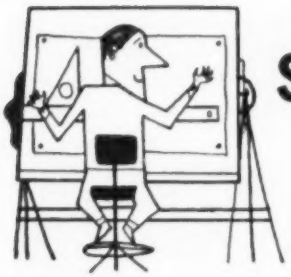
A NEW metal powder for reclaiming crankshafts by a metallizing process has been developed by the Wall Colmonoy Corp. Anti-friction qualities of the surface produced permits increased horsepower and longer crankshaft life.

The new material, Colmonoy C-250, is a high chromium-nickel powder containing chromium borides. It features low coefficient of friction, controlled surface porosity and good oil retention properties. Results of a test indicate its effectiveness.

A GMC truck with an engine having a crankshaft metallized with Colmonoy C-250 was run for 100,000-miles pulling a payload of 25 tons. The crankshaft and bearings retained nearly original dimensions. Wear was slight enough to reuse original components and oil pressure was unchanged.

The step-by-step metallizing procedure follows: First degrease thoroughly. Then grind journals 0.060-in. to 0.080-in. undersize on diameter. Next grit blast one journal at a time. Then plug oil hole with asbestos rope and spray one journal at a time. Wrap sprayed journal tightly with sheet asbestos, and after spraying all journals remove asbestos and plugs. Then wet grind to finish size and coat with oil or grease.

Cleanliness and proper grit blasting are essential in this process. These largely determine the quality of the mechanical bond. Grit blasting and spraying one journal at a time insures positive cleanliness and minimizes contamination in handling and storage. Wrapping journal with asbestos permits slow cooling and a better sprayed surface. Finish grinding is best accomplished with a medium silicon carbide wheel.



service section

Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you

Caterpillar Engine Lubricants

Only those lubricating oils known as Superior Lubricants (Series 3) are recommended for use in the crankcase of D13000 diesel engines having serial numbers 1T1 and up, and in the engine crankcase of the D8 tractors 13A series. When the fuel sulphur content is 0.4% or less, the oil change period and filter change period should be 240 hours. If the fuel sulphur content is from 0.4% to 1.0%, then the oil change period and filter change period should be 120 hours.

As a reminder, let us briefly review the crankcase lubricating oil recommendations for D326, D337 diesel engines and DW20, DW21 tractors. Only those oils known as Superior lubricants (Series 3) are recommended for use in these engines. The oil change periods for the above diesel engines are as follows: When the fuel sulphur content is 0.4% or less, the oil change period and filter change period should be 120 hours. If the fuel sulphur content is from 0.4% to 1.0%, the oil change period and filter change period should be 60 hours.

Widespread availability of Superior Lubricants (Series 3) and diesel fuels of low sulphur content has eliminated any need for the copper cylinder liner sleeves or shields originally used to retard liner corrosion. Those replacement cylinder liners now available from the parts department no longer include the sleeves.

Cleveland Diesel Head Refacing and Valve Seat Grinding Limits

The information contained herein is to supplement that outlined in the engine maintenance manual with reference to the proper maintenance of the exhaust valve seats and/or the cylinder-head-to-liner gasket surface.

Attention is called to the fact that values "A" will be reduced by the amount removed from the face of the cylinder head if and when the cylinder head requires refacing.

It is of utmost importance that the bottom face of the cylinder head be kept perfectly smooth and flat. Also

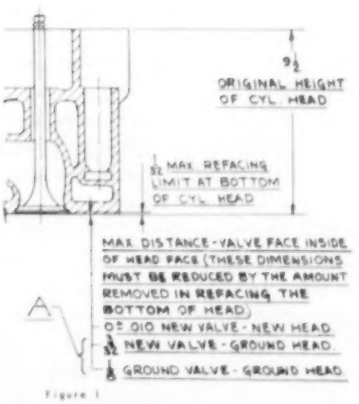
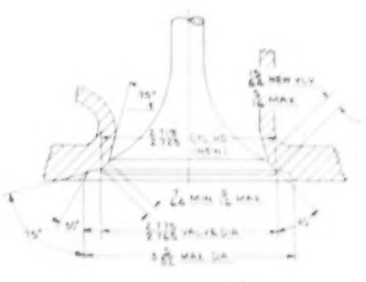

9½
ORIGINAL HEIGHT OF CYL. HEAD
½ MAX. REFACING LIMIT AT BOTTOM OF CYL. HEAD
MAX. DISTANCE - VALVE FACE INSIDE OF HEAD FACE (THESE DIMENSIONS MUST BE REDUCED BY THE AMOUNT REMOVED IN REFACING THE BOTTOM OF HEAD)
.010 NEW VALVE - NEW HEAD
NEW VALVE - GROUND HEAD
GROUND VALVE - GROUND HEAD
A

Figure 1

the three counterbored holes in the bottom face of the head must be re-



bored by the amount of material equal to that removed in refacing.

Refer to Fig. 1 for dimensions relating to the foregoing and to Fig. 2 for face width limits of valve and cylinder head.

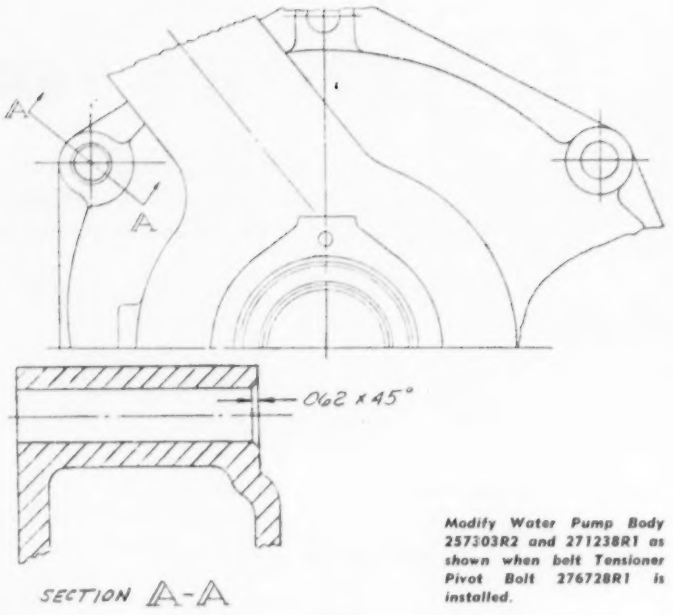
Service Section

(Continued from page 65)

IH Belt Tensioner Spring

A new belt tensioner spring, 274 982 R2 is released for the U-1091 and UD-1091 Power Units, TD-24 Gear Driven and Torque Converter Crawler Tractors. This displaces belt tensioner spring, 274 982 R1. The new spring will eliminate possibility of compressing the spring to maximum solid height within each adjustment of tolerance.

A new belt tensioner yoke pivot bolt, 276 728 R1 has also been released for use on the above mentioned model machines and displaces bolt, 274 988 R1 and water pump body stud, 274 997 R1. A belt tensioner yoke pivot bolt service package, 276 775 R91 is also released.



Modify Water Pump Body 257303R2 and 271238R1 as shown when belt Tensioner Pivot Bolt 276728R1 is installed.

Servicing Detroit Diesel Engines

Evidence from the field indicates that seasonal maintenance is being overlooked by many operators.

A unit operating throughout the year should be cleaned and inspected at least four times during that year.

To get long and useful engine life and insure a successful operating season the following should be checked and if necessary, corrected.

1. Proper adjustment of injectors, valves and governor.

2. Proper air flow through air cleaners, screens, mufflers and exhaust piping.

3. Proper fuel flow through the strainer and filter and adequate fuel pressure to injectors.

4. Proper lubricating oil flow through strainers and filters with adequate oil pressure at the bearing journals.

5. Proper coolant flow through the engine and radiator and also a sufficient oil supply to the underside of the pistons, maintaining the proper temperature of these items.

6. Alignment of engine with power take-off assemblies and drive units.

7. Proper ventilation for engine and the elimination of recirculating air through the radiator.

8. Proper care of battery and electrical equipment.

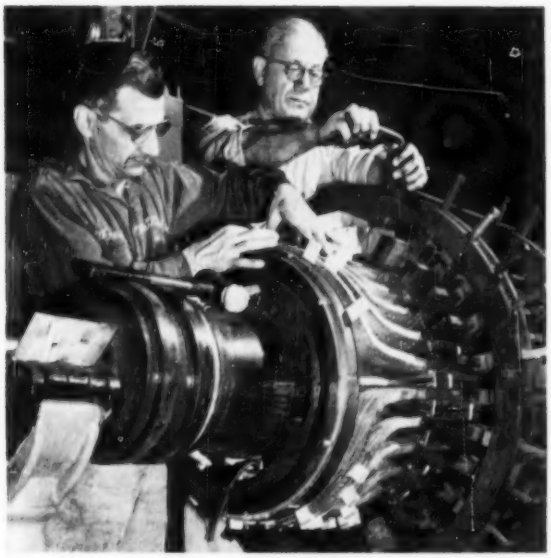
9. Proper storage of fuel and lubricants.

10. Proper use of tools when servicing and overhauling the engine and related parts, plus cleanliness when working on internal parts.

The following should be checked before putting an engine into service or after storage.

1. Engine Tune-Up.
   a. Valve clearance.
   b. Injector follower height.
   c. Governor gap setting.
   d. Injector rack control lever position.
   e. Maximum no-load speed.
   f. Idle speed.
   g. Buffer screw adjustment.
2. Fuel System.
   a. Quantity of fuel returned to the tank per minute without any air bubbles present.
3. Air System.
   a. Air inlet restriction.
   b. Air box pressure.
   c. Exhaust back pressure.
   d. Compression pressure.
4. Lubrication System.
   a. Lubricating oil pressure.
   b. Crankcase pressure.
5. Cooling System.
   a. Coolant temperature.
   b. Thermostat operation.
6. Electrical System.
   a. Battery charge.
   b. Regulator settings.
   c. Generator brush length and tension.

news of our industry



Large Industrial Repair Center

One of the nation's largest industrial repair centers, equipped for emergency repair or overhaul of anything from a small motor to a locomotive, was recently opened to serve the greater New York area.

Harold Bongarten, manager of the new shop, said facilities will operate twenty-four hours a day, including Sundays and holidays, with maintenance specialists on call at all times. The shop is geared to handle repair of all marine, transportation, and industrial-utility electrical equipment. It repairs, reconditions, or overhauls all apparatus-type equipment as large as propulsion power units for ocean tankers, freighters, and liners.

To speed repair on locomotives, an "inside-the building" railroad siding was installed. Cranes, capable of lifting up to fifty-ton, move the huge equipment from the siding to the repair section.

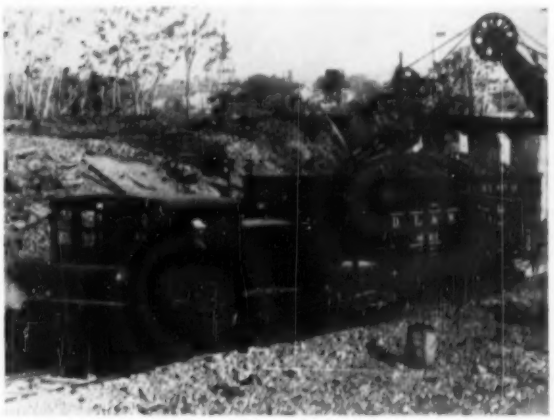
Some of the equipment visitors to the repair plant see are radio-telephone equipped delivery trucks, operating within a 100-mile radius of the North Bergen (New Jersey) location; a motor-exchange service for in and out of warranty repairs in the small-motor section; ten overhead trolley-cranes, operating by remote control; two of the largest industrial bake-ovens, with a maximum heat of 650°, to cure varnish and dry out electrical equipment; a distribution transformer rebuilding line, completely automatic, which uses an infra-ray oven for "baking"; and modern inspection equipment for testing anything from fractional horsepower motors to giant turbine generators.

Diesel Saves $1000 per month

Replacing a 70-ton six-wheel steam locomotive with a new 35-ton Plymouth diesel-hydraulic locomotive has resulted in remarkable savings in fuel costs at the Philadelphia Slag Co. Their new diesel, put into service in February, 1954, has performed the same haulage job with a reduction of more than $1000 per month in fuel costs over the last 2½-years.

Both locomotives were used to haul battleship cars of slag from bank to plant on a daily schedule. The steamer required up to 25-tons of coal weekly. The diesel does the same work with an average weekly consumption of only 75-gal fuel oil.

According to the Superintendent of the slag company: " . . . Simple arithmetic shows that the savings affected by the use of our diesel have already equalled the cost of the new locomotive. Needless to say, we are very well satisfied with our locomotive's performance and pleased that we made the change to diesel operation."



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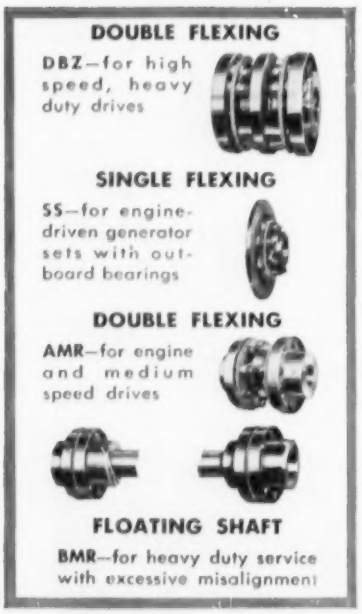
Coupling problem?

THOMAS will help select your coupling


DOUBLE FLEXING
DBZ—for high speed, heavy duty drives
SINGLE FLEXING
SS—for engine-driven generator sets with outboard bearings
DOUBLE FLEXING
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Your Thomas Sales Engineer, backed by 40 years of coupling experience, will help you select the correct type Flexible Coupling from the Thomas catalog. Or, he will engineer special variations for unusual cases. For all practical purposes, properly installed and operated within rated conditions, Thomas Flexible Couplings will last *forever*.

NO LUBRICATION • NO MAINTENANCE
THERE ARE NO WEARING PARTS

Under load and misalignment, only Thomas Flexible Couplings offer *all* these advantages:

1. Freedom from backlash—torsional rigidity
2. Free end float
3. Smooth, continuous drive with constant rotational velocity
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5. Original balance for life

Write for Engineering Catalog 51A and the name of the Thomas Flexible Coupling engineer nearest you.

THOMAS FLEXIBLE COUPLING CO.

WARREN, PENNSYLVANIA, U.S.A.

news of our industry

Ocean Floor "Eye"

Magnolia Petroleum researchers have developed a geological "eye" that peers beneath the surface of the ocean floor into earth formations for a depth of several hundred feet, and tells what they're made of. Called the Sonoprobe, it is a useful reconnaissance tool for off-shore drilling.

Locomotives for Mexico

National Railways of Mexico has purchased ten diesel-electric locomotives for mainline passenger and freight service from General Electric. Price: $ nearly two million. Purchase is part of a modernization program.

Argentina Orders Diesels

Argentina State Railways has placed a $5½ million order for 25 diesel-electric locomotives with General Electric, as part of a general revamping plan. Delivery is scheduled for 1958, when they will join 100 similar units that have been in use since 1947.

Bearing Price-Rise

Timken Roller Bearing Co. has announced an across-the-board price rise in its bearing line averaging 7%. A spokesman said the rise was necessary because of higher costs.

Signals to Current

Mechanical and pneumatic signals can now be converted to DC current for long-range transmission, and then reconverted to pneumatic pressure for actuating control valves or other pneumatic equipment.

The new system (developed by Robertshaw-Fulton) permits low-cost remote measurement, indication, and the recording and control of process variables by the elimination of electronics and complex circuitry.

The first commercial installation will be made within the next few months.

New "Square house"

A new $1,500,000 "square house" for the inspection and maintenance of diesel and electric locomotives will be placed in service by the Pennsylvania Railroad at Morrisville, Pa. Simultaneously, the old house and shops at Trenton (New Jersey) will be closed.

Unlike the "round house" of steam locomotive days, the new building will be a "pass through" shop.

B&M Buys New Diesels

Directors of the Boston & Maine Railroad have approved the purchase of 50 all-purpose 1750-hp diesel locomotives at a cost of $9 million. This will bring the new management's expenditures to $44 million since last January, when they assumed control.

Railroad "Piggy-Back"

Seventeen diesel locomotives and twenty-four refrigerator cars are traveling on flat car to Newfoundland, where they will be used. There, the tracks are 14-in. narrower than on the mainland.

Because of the value and nature of the cargo, speeds in excess of 25-mph are prohibited while enroute.

Shot Peening Shafts

Some crankshafts used in Cat diesels receive a peening treatment known as shot-peening. The process is similar to sand blasting, except that metal shot is used instead of sand. Each shot, directed at the shaft, acts as a small hammer when it strikes the surface. This process increases the fatigue life in areas of high stress.

Commuter Comfort

Another step to turn the commuter from his own transportation to mass-transportation mediums is the installation low-cost air conditioning units for year-round passenger comfort. Trane (air conditioning) spokesmen stated that a high degree of comfort is the simplest commuter lure when competition for the commuter is at its keenest.

news of our industry

Also to Argentina

White Diesel announced an order for four engine-generator sets valued at $450,000. This is the second major South American order announced by White in recent months.

"Electrojector"

Bendix Aviation has developed a fuel injection system for automobiles that operates electronically. The system is called electrojector.

It uses transistors. Bendix says it provides a practical solution to the problem of supplying a precisely synchronized supply to each cylinder under every possible operating condition. It does not require a special drive off the engine.

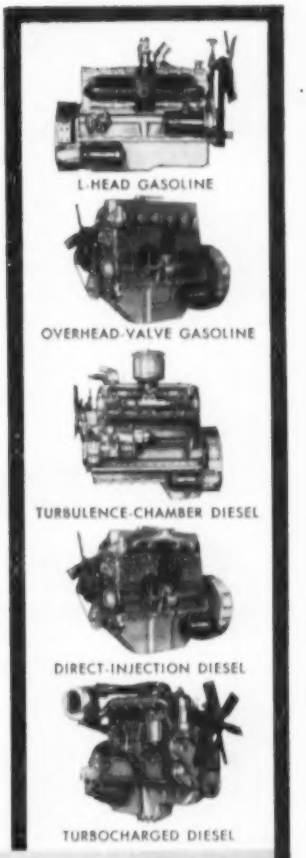
Truckers Credit Agency

The trucking industry's Credit Committee is exploring the possibility of establishing a Trucking Credit Agency. This agency would be able to offer longer term-financing of trucks and trailers than has been available to most trucking firms. In addition, a survey will be made of trucking terminal capacity, to support a plea to the federal government for further grants of accelerated amortization for tax purposes. A third step is in the direction of extending the range of SBA loan assistance.

Diesel Speedliner

A self-propelled diesel-powered "Daylight Speedliner" (Budd Co.) will operate an all-daylight service between Philadelphia, Baltimore, Washington and Pittsburgh on the B&O main line over the Alleghenies. The all-stainless-steel train is not an experimental model; but is based on designs proven by use, experience and passenger acceptance. "It is", said pres. Simpson (B&O), "the logical development of the self-propelled rail diesel car, with its known safety and speed factors, and also provides the added features of economy, comfort, and simplicity of operation."

This is HERCULES MOTORS Today



DEPENDABLE POWER FOR INDUSTRY

Yes, this is Hercules Motors, today—all types of dependable power for modern industry. The Hercules line includes more than 90 different models of engines and complete power units ranging from 3 to 500 H.P.

An ever-growing list of customers are solving their power problems with these types of Hercules Engines: L-head gasoline, overhead-valve gasoline, natural gas, L.P.G., turbulence-chamber diesels, direct-injection diesels, Turbo-Charged Diesels, marine diesels and complete open, closed and base type power units.

Write for more information on any of these dependable power plants. Our sales-engineers will be happy to help solve your power problems. No obligations, of course.

HERCULES MOTORS CORP.

Engine Specialists Since 1915 • Canton, Ohio

news of our industry

Emphasis on Marketing

In a drive to diversify the MM line, Minneapolis-Moline has appointed Stephen K. Plasman as Manager of Market Research. Mr. Plasman will organize an all-out search for new markets to absorb the enlarged manufacturing potential of this century-old company, including a new line of crawler-tractors.

A New Instrument

Fordson Major diesel tractors are being equipped with a new "Proofmeter" all-in-one instrument that indicates rpm, hours of operation, and ground, power take-off, and belt pulley speeds.

Locomotive Purchase

The Costa Rican government has purchased 14 diesel-electric locomotives from General Electric, for a total of about $1,300,000. The new engines will replace 34 older steamers.

Industrial "Road Show"

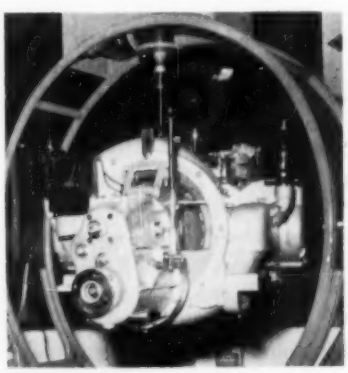
Aluminum Company of America is showing a new impact extrusion process to industrial designers and engineers. They have a few good ideas that may be used in our industry, such as the inexpensive, lightweight extrusions shown below. A few good uses are obvious.

Diesel Conversions Overseas

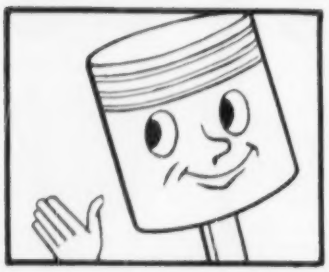
Following the trend for more horsepower from a smaller portion of the fuel dollar, European equipment operators are also converting their gasoline engined rigs to diesel. In Sweden, the Volto T-30 farm tractor conversion kit is being marketed, and in Britain, the Albion conversion kit is available for their vehicles.

French Diesel for Auto

One of the exhibits at the recent International Auto Show, held in Paris, was this Enfield diesel engine-transmission combination. Lightweight and compact, it readily lends itself to automotive application. Incidentally, the fuel oil filter is of American manufacture (Fram).



CEMENT SHEATHS
guard gulf wells

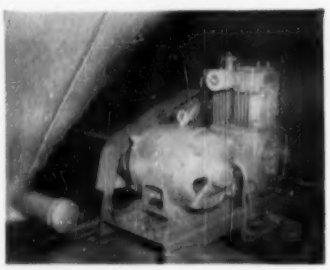


by Cecil Diesel
ROVING REPORTER

PORT OF NEW ORLEANS—"What kind of ship is *this?*" I ask Skipper as the twin 270 HP Caterpillar marine diesels settle down to work. (I see another pair of Caterpillars, D3-18's, there in the engine room teamed with 40 KW generators.)

"This is one of the fleet of seagoing Halliburton cementing ships," he says. "Our deck tanks are filled with cementing materials. We're headed for some offshore oil drilling rigs, where we'll protect well casings with sheaths of cement. Pump it down as a liquid with power from three Cummins NHRBS 600 diesels.

"For starting . . ." he goes on, "we've got two D-340 Quincy compressors — one forward, one in the engine room. Use them to operate cement discharge valves and air-over-hydraulic controls for the ship itself, too!"



Quincy has a compressor for your diesel starting job, too. Let them help you select the right model from a range of mountings and sizes — from 1 to 90 CFM. Write them for a catalog today.

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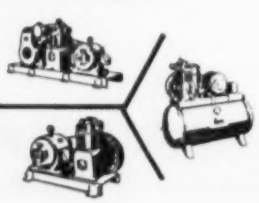


World's finest air compressors.

news of our industry

Facilities Expanded

Winslow Engineering & Manufacturing Co., manufacturers of fuel and oil filters and elements, has doubled production facilities at its Murray, Kentucky plant.

"Bus of Tomorrow"

Mack's answer to the commuter using his own car rather than the bus is the new concept in transit-type bus shown below. Note the increased visibility for both driver and passenger.

Aluminum Bearings in Britain

Aluminum as material for bearings in commercial diesel engines in the United Kingdom is on the upswing. American diesels use aluminum bearings extensively, following the research done in this field by the Aluminum Company of America.

And Speaking of Aluminum

Progress is being made in aluminum engine construction. Alcoa collaborated with American Motors in making a small (62-hp) engine composed of a great many aluminum castings. Such technology can be expected to show up in commercial engines.

In Case You Didn't Know

The Society of Automotive Engineers has moved its headquarters to 485 Lexington avenue, New York.

And Don't Forget

The 1957 "Road Show" is going to be held in Chicago next January. This World's Fair of the Construction Industry is a good chance to look over the newest developments in construction equipment.

New Export Department

Superior Tube Company has established an Export Department to promote foreign sales and develop markets.

Modern Highway Tractor

GMC Truck & Coach Division announced it would exhibit at the New York Automobile Show a new highway tractor with air suspension, lightweight aluminum construction, and a turbocharged diesel engine that will feature a new economy for the trucking industry.

New Tractor Plant

To meet the high level of production expected in the next few years, Euclid (GM) is putting up a new tractor plant in Hudson, O.

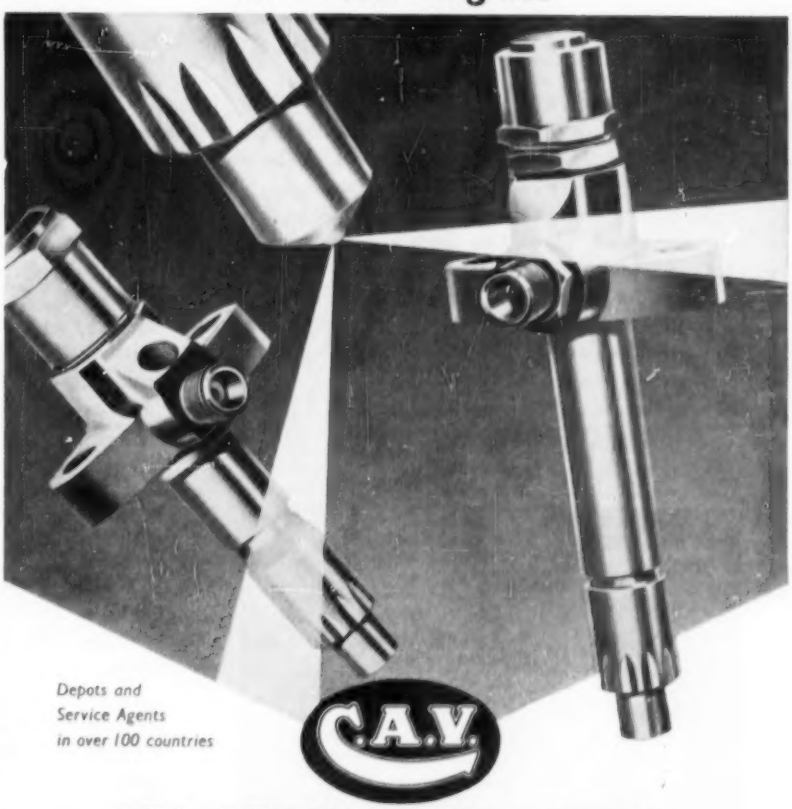
New ASCE Division

In recognition of the rapid and extensive development of the pipeline industry and the wide variety of many of its members in that field, the American Society of Civil Engineers has announced the creation of the Pipeline Division.

The World's Leading Manufacturers of

FUEL INJECTION EQUIPMENT

for Diesel Engines



Depots and Service Agents in over 100 countries

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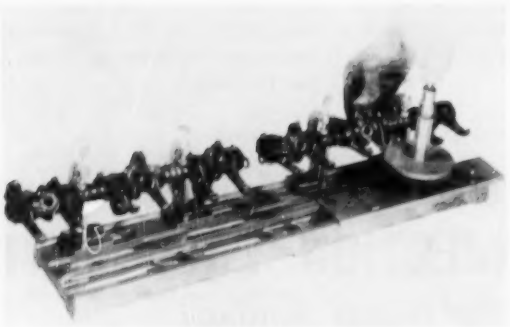
Joseph Lucas (Canada) Ltd., Head Office: 11 Davies Avenue, Toronto 8, Ontario

Branch Office: 3401 St. Antoine Street, Montreal 30, Que.

AP174-819

new products



Portable Rocker Arm Resurfacer

A precision, lightweight, portable rocker arm refacer is being marketed by Storm-Vulcan. It is designed to quickly restore factory finish and contour by resurfacing with rocker arms in operating position.

The model 911 Rocker Arm Refacer resurfaces an average set of rocker arms in approximately five minutes. Accuracy is assured in a few seconds.

In operation, four adjustable vee-clamps on the base hold the entire assembly rigid and parallel to the grinding surface. The grinding wheel is driven by any valve seat grinder, drill motor or impact wrench.

Chronometric-Type Tachometer

Three versions of the Jaquet speed indicator are available from Hermann H. Sticht, Inc. These are the standard model, the model "M", and the model "E". All models are imported from Switzerland.

All three speed indicator models are small in size, with a diameter of about 2¼-in. and only about 1-in. deep. About as big as a good size pocket watch. Yet they are extremely accurate revolution counters and surface speed indicators combined with a chronometer that times the test.

Timing period and counting of the revolutions are synchronized by a push-button, eliminating entirely the personal equation. This minimizes the opportunity for error. Timing period is usually six seconds, with accuracy of rpm or surface-speed reading within ½ of 1%.

Metal Repair Kit

A kit to repair metal surfaces is available from the Devcon Corp. The manufacturer claims that within two hours the mixture becomes tough enough to be sawed, drilled, threaded, or ground with regular metal-working tools.

Devcon bonds a variety of metals to themselves and to other metals. It is now being used to rebuild broken machinery, fill holes in castings, build-up surfaces, etc. Resistant to most chemicals, usage is reported in oil refineries, mines, and power plants to repair general industrial equipment. The manufacturer also claims successful use in repairing diesel engines of one fleet.

Available in two forms (putty and liquid) the plastic steel contains 80% steel and 20% plastic. Compression strength is 18,000-psi, and it hardens with practically no shrinkage. Surface is durable, and may be machined to a feather edge.

new products

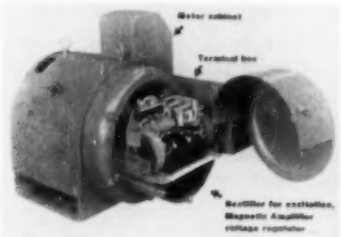
New Hose Ends

The Weatherhead Company, Fort Wayne Division, announces a new clamp-type hose end, which provides maximum versatility in high-pressure lines for air, hydraulic fluids, steam, etc. It couples readily on other types of hose, and meets practically any original equipment or field replacement hose end need. Installation is simple, requiring no hose skiving or special tools.

Also announced are the model H-69 Reusable hose ends. This design is particularly suitable where medium-high pressure, cotton covered, single wire braid hose is required.

Simple "Packaged" Generator

The new "Amp-Pak" packaged generator introduced by Electric Machinery Mfg. Co. uses a built-in rectifier for excitation instead of a conventional rotating exciter, and a magnetic amplifier voltage regulator, with no moving parts or vacuum tubes, to provide accurate, quick response voltage regulation. The static arrangement eliminates much conventional maintenance.



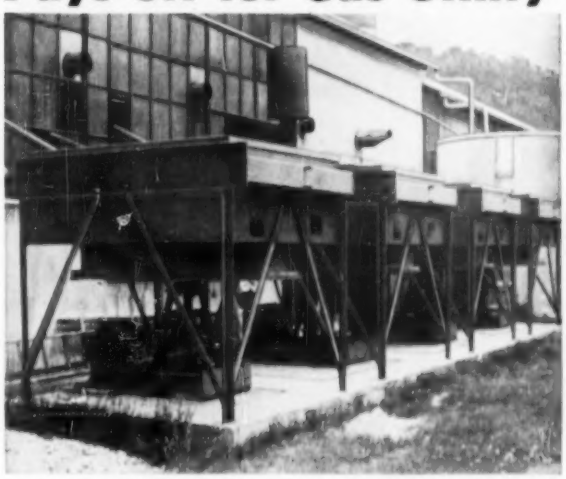
New Lorain 56

A new model in the Thew Shovel Co. line of Lorain power shovels is the fully air-controlled 1¼-yd Lorain 56. It is convertible to shovel, crane, clamshell dragline, or hoe service. Most salient of the new features is the 2-lever "metered-air" controls.

Power for the new "56" is from a Cummins diesel engine with torque converter and a disconnecting 2-plate clutch.

Young Engineering Talent

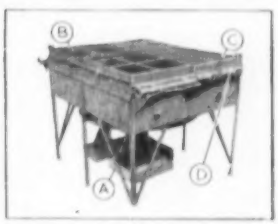
Pays off for Gas Utility*



*South Penn Natural Gas Co. Station, Smithfield, West Va.

Young "HC" Atmospheric Radiators

eliminate cooling water supply problems



The Problem: To replace an old cooling tower serving gas compressors. A nearby creek furnished the uncertain water supply.

How Young solved it

Young HC Horizontal Core Cooler and Condenser

Four Young Radiator Company HC Atmospheric Radiators were specified to cool four 165-hp compressor engines. Natural gas is compressed from local field lines and well-head to pressures suitable for shipping to distant sales points. Installation of the Young Units has modernized the compressor cooling system. In addition it has made the utility independent of the uncertain water supply.

A. Independent mounted fans eliminate unit vibration.
B. Coils designed for easy access to tube ends.
C. Coils supplied for any operating pressure.
D. Steel tanks treated for corrosion resistance.

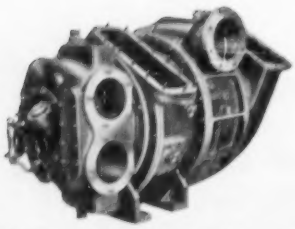
Write Dept. 416-M for FREE Catalog

Put Young Talent to work for you . . .

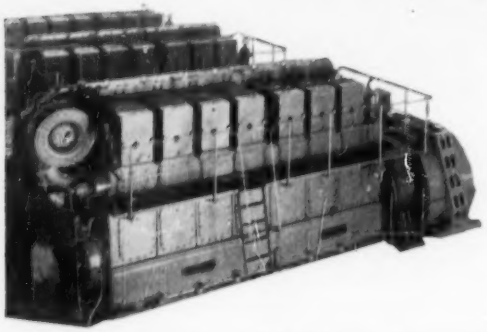
Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

HC is a registered trademark.

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY
Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.
Executive Office: Racine, Wisconsin. Plants at Racine, Wisconsin, Mattoon, Illinois



'English Electric' chose Napier Turbo-blowers



for these alternator sets

which provide the power for this island

A Napier TS400 Turbo-blower is fitted to each of the three 'English Electric' 7SRL Diesel alternator sets installed in the Saateni Power Station, Zanzibar. These alternator sets provide the island's entire power supply. Why did 'English Electric' choose *Napier* blowers? Here are three good reasons:

- Napier blowers have *high adiabatic efficiency*, resulting in maximum power increase and low fuel consumption.
- Napier blowers are backed by a world-wide service and spares organisation.
- Napier's long experience in the design and manufacture of aircraft engines and gas turbine machinery guarantees a high standard of workmanship. Napier Turbo-blowers are available in seven sizes for engines of 140-5,000 b.h.p. afloat and ashore. Multiple installations for engines of higher powers. On 4-stroke Diesels they can double the power, on 2-strokes they increase it by over 30%—often at a lower specific fuel consumption. Napier Turbo-blowers are currently in service in 69 countries.

NAPIER Turbo-blowers

D. NAPIER AND SON LIMITED · LONDON · W.3 · ENGLAND

REPRESENTATIVE: L. O. BROOKS, SUITE 909, DUPONT CIRCLE BUILDINGS, 1346 CONNECTICUT AVENUE N.W., WASHINGTON 6, D.C. TEL: DUPONT 7-2123

CRC T13

new products

Double-Universal Joints

A complete series of double-universal joints is now available for slow speed application up to 300-rpm, by Lovejoy. Thirteen standard sizes provide a horsepower range from ½ to 207-hp at 100-rpm, static torque from 340 to 130,700-in. lb. Maximum operating angle is 90°.

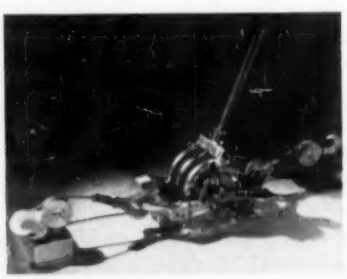
Joints can be supplied solid or bored, with hub diameters from ½ to 4-in. Standard lengths run from 4-in to 21¼-in. However, since many applications require varying lengths, sizes can be furnished to meet all specifications. All components are precision made.

Self-Contained Cable Unit

This heavy-duty, manually-operated power tool was designed to safely lift, lower, or pull. With a cable capacity of 7000-lb, the manufacturer claims that one man can use it with ease. It is a handy tool for inching heavy weights, engine handling, etc.

It is available in either single or double reel models, with a maximum cable capacity of 100-ft. Self-contained servo-action brakes are located on each side of the reel, and are constructed to prevent accidental release of the load.

A precision-built tool, it is designed for maximum durability.



new products

Socketless Hose Fitting

Aeroquip has released a socketless fittings and hose kit #5142. The maker claims that a hose can be cut with a pocket knife, pushed on the fitting, and it will remain without additional effort. It is designed for fuel and lube lines, as well as related applications.

Hydraulic Parking Brake

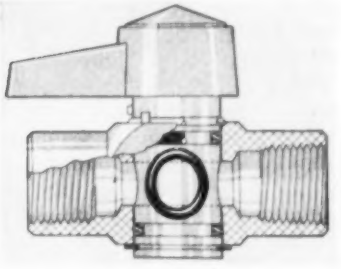
Manually-controlled parking brakes for cranes and other rail-guided equipment not having uninterrupted power have been introduced by Wagner Electric. The new brake operates entirely independently of electric power, and is suitable for use on all types of engine-driven equipment.

"O" Ring-Seal Valve

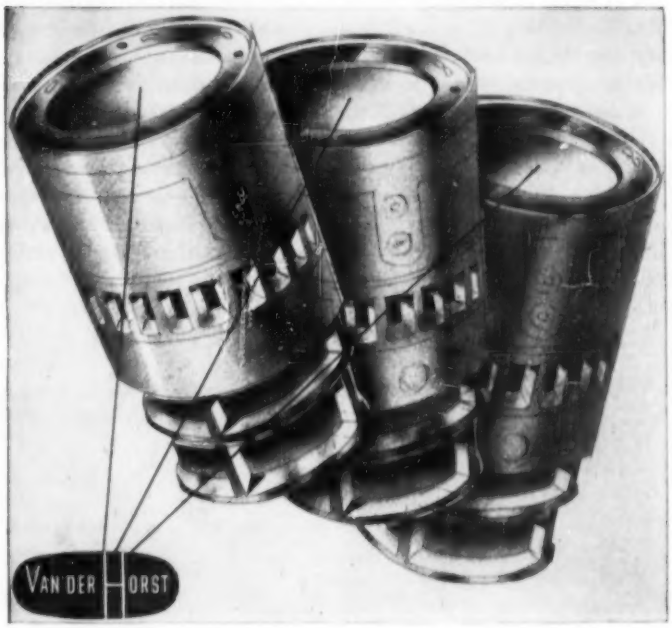
A plug valve that provides leakproof shut-off operated by a handle that opens and closes against pressure with absolutely no effort is now being manufactured by Circle Seal Prod.

The design of the plug features the use of three "O" rings. In the closed position, one is contained on the surface of the plug (90° from the flow passage through the plug) and serves as a flow seal. This ring surrounds the inlet port and provides tight shut-off. In the open position, the valve is full ported for straight-through flow. Static "O" rings at top and bottom of the plug and around its circumference prevent stem leakage.

Use of "O" rings eliminates adjustments for maintenance-free service. The brass valve is available in ¼-in. female pipe connections.



5 *big advantages of*



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Good for the Life of your Engines

PORUS - KROME INCREASES PISTON RING LIFE UP TO 50%.

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PORUS - KROME DEFINITELY CONTRIBUTES TO A REDUCTION IN LUBE OIL CONSUMPTION.

PORUS - KROME DEFINITELY CONTRIBUTES TO REDUCED DOWNTIME FOR ENGINES.

PORUS - KROME ELIMINATES STOCKING OF OVERSIZED PISTONS AND PISTON RINGS.

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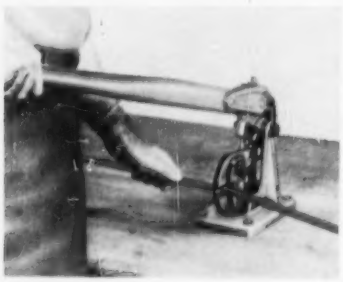
TERRELL, TEXAS
LOS ANGELES, CALIFORNIA

new products

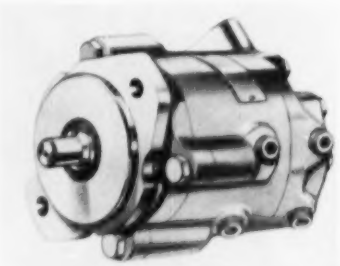
Heavy-Duty Metal Cutter

The Porter Heavy-Duty Work-Station Cutter is a labor and time-saving way to cut bolts, wire, rods, chains, strap stock, wire rope, cable, etc. without leaving the work station. It is designed for installation where these operations are frequent or repetitive. Easily secured to any firm mount, it handles stock up to ½-in. thick, and is available with a variety of jaws for specific cutting tasks.



Hydraulic Piston Pump

A moderately-priced hydraulic piston pump has been announced for high-pressure hydraulic systems by Dynex, inc. The pump, series PF-3006, is ruggedly designed for use with construction machinery, materials-handling devices, agricultural equipment, test stands and presses in both original equipment and replacement markets. Rated pressure is 2000-psi; intermittant 3000-psi. Unit may be mounted in any position, with shaft rotation in either direction.



High Efficiency Air Filter

A dry-type, renewable-media high-efficiency air filter has been developed by American Air Filter. It is especially suitable for operating in chemical plants, labs, or certain precision-type manufacturing plants.

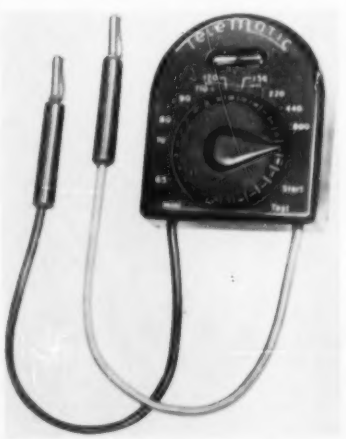
Multi-pak was developed for these applications that need air filters of standard construction; but higher-than-normal cleaning efficiencies. It is claimed that it will even filter out tobacco smoke. The type or degree of filtration is determined by the particular filtering media employed.

Emergency Generator Sets

Harnischfeger P&H Corp has a revamped line of diesel-driven emergency generators. They are aimed at usage in hospitals, radio stations, telephone exchanges, and industrial centers that are helpless in the event of a power failure. If the regular high-line source is suddenly cut off, these sets automatically go into operation and provide power until repairs can be made.

Pocket Voltage Tester

Mini-Test, a pocket-size voltage tester, will check unknown voltages from 65-v to 800-v, and determine whether current is AC or DC. Voltages are read directly from the dial, eliminating guess work. Hands are free to work while Mini-Test is being used, due to the clip-on leads. It is low-priced and guaranteed by Omega Products.



CAN YOU TOP THIS? 99.95% WATER REMOVAL FROM DIESEL FUEL! TRAPS TREMENDOUS DIRT LOAD TOO.

ONE tank does BOTH jobs!

THIS NEW BRIGGS, DUAL-USE, SINGLE-STAGE FILTER/SEPARATOR IS DOING AN AMAZING JOB ON EVERY INSTALLATION.

STOP INJECTOR PITTING and corrosion, once and for all . . . . lick the headaches of down-time due to abrasion . . . . with the best FILTER and WATER SEPARATOR you can buy — all in one single compact unit. COMPLETE PROTECTION for all engines in ONE OPERATION with the special fiber glass filter/separator element.

Briggs

FILTER / SEPARATORS

USE THE COUPON TO GET ALL THE LATEST DATA ON THIS VITAL SUBJECT.

THE BRIGGS FILTRATION COMPANY, Washington, 16, D.C., Dept. 142

YES! Send me booklet on Water and Abrasives Removal from Fuel Oil.

Name .....

Company .....

Address .....

new literature

Filter Information
concerning fuel & lube oil, cooling water, and gas dehydrators is available in a catalog prepared by the Rol-Pak Co. It includes info on how to select the proper filter, and about the things you should look for in a filter of any kind.

Safe Detergent
An illustrated 2-color 12-pp booklet describes Immunol, a non-alkaline non-acid detergent and rust preventative that cleans, degreases and rust-proofs in one operation. The manufacturer, Harry Miller Corp., also lists a variety of other uses.

Nordberg Type TS-21
diesel and duafuel engine is discussed in a 20-pp 3-color brochure. Cross-sections, diagrams, and photographs show details of the engine's construction and operation, including the cylinder lube system and the fuel system.

DC Motor-Generator Sets
including DC motors, ½ through 2000-hp, and motor-generator sets up through 200-KW output are described in a new bulletin released by Allis-Chalmers.

SAE Boss Fittings
A new Anchor catalog illustrates and describes Anchor Coupling's new line of SAE boss fittings and "O" rings adapters, designed to satisfy the new SAE standards. It shows a wide range of sizes and styles, as well as their line of tube nuts.

Hydraulic Fan Drives
are discussed in the DeLaval Steam Turbine Bulletin 3009. Six pages describe hydraulic fan drive for air-cooled heat exchangers and cooling towers, as well as IMO motors and pumps. Also included are a series of performance curves, aimed toward quickly selecting the correct pump for a specific application.

Gasket Catalog
As a help to users of gaskets, shims and washers, Chicago-Wilcox has released a 28-pp catalog illustrating and describing these products in a variety of styles, shapes and materials.

Collodial Dispersion Lube
A compilation of current practices in high-temperature lubrication with collodial dispersions is contained in Bulletin #423, published by Acheson Colloids.

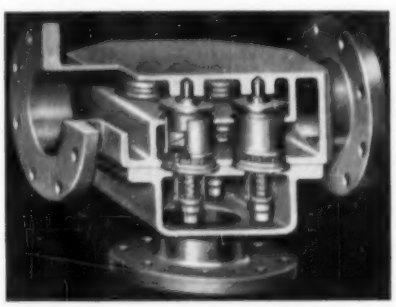
Aluminum Insulation
Kaiser Aluminum has released a comprehensive, illustrated manual on aluminum insulation jacketing for tanks, vessels and piping systems in the petroleum, power, and other process industries.

Impact Testing
"Symposium on Impact Testing" is available from ASTM. It discusses impact and shock tests for parts, components, and complete structures.

Vee-Belting
Construction features of "Texrope" grommet vee-belt, claimed to provide up to 50% longer life, are described in a new bulletin by Allis-Chalmers.

Parts Fitting
Timesaver Products has issued a technical booklet on the use of their Lapping Compound as a means of fitting bearings, gears, slides, pistons, etc.

Vertical Turbine Pump
questions are answered in a comprehensive book "The Answers to your Questions about Layne Vertical Turbine Pumps", published by Layne & Bowler, inc. It is written by an authority on this type pump, and covers the usage for municipalities, industry and irrigation. Another section deals with well-pump corrosion.



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AMOT

JACKET WATER & LUBE OIL THERMOSTATS

SAFETY	Provided for by multiple independent elements as shown above.
✓	Provided for by rugged AMOT element construction. No AMOT element has ever stuck closed since its introduction 6 years ago. Many years of "know how" are built into every AMOT element.
✓	Omission of all hand operators means engine temperature is safe from tampering by engine attendants. AMOT is the only engine thermostat that can be considered safe without a hand operator.
✓	Lack of capillary tubes, bulbs, and packing glands means no failures from kinks or leaks.
SERVICE	There is only one replaceable part—the element. Renewal of element renews all working parts. Element replacement, if ever required, is several times faster than on any competitive make. Original accuracy of temperature setting is always provided in element replacement.
✓	AMOT engineers are available in most major cities to help on application and other problems.
✓	Most models are available from stock for rush orders.
MODELS	½" to 6" pipe sizes. Larger sizes in iron, bronze or ductile iron.

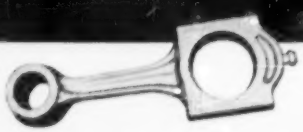
AMOT CONTROLS CORPORATION • FIRST ST. & NEVIN AVE. RICHMOND, CALIFORNIA

Park DIE-FORGED

CRANKSHAFTS

CRANKCASE PARTS

CONNECTING RODS



Are the Strongest "Links" in your Power Transmission Chain

For over 49 years, Park has specialized in the closed-die forging of crankshafts, connecting rods, camshafts, crankcase parts, main bearings, gears, pinions, axles and steering knuckles.

Park's facilities include a complete die sinking shop, modern specialized heat treating equipment and experienced metallurgical and engineering staffs.

Die Forging Specialists Since 1907

THE PARK DROP FORGE CO.
CLEVELAND 3, OHIO

CARBON, ALLOY AND STAINLESS STEEL CLOSED-DIE FORGINGS FROM 4 LB. TO 5000 LBS.

new literature

Engine Case Histories

Four of a series of engine case histories have been published by LeRoi Div. of Westinghouse Air Brake. Pictures and illustrations show the savings employed after the installations. Applications described are air conditioning, gas boosting, cotton ginning, and irrigation.

Long-Last Fencing

Bulletin DH-16 describes a wear and time resistant fencing for the protection of powerhouses, supplies and equipment, etc. Published by American Chain & Cable Co., Page Steel & Wire Division.

"Lubrication Engineering"

journal of the A.S.L.E. will be published monthly beginning Jan. 10, 1957. Closing dates for the first issue will be one month prior to the release date.

Alco Review

The Fall, 1956 issue of Alco Products Review features a descriptive article on thermal rating of heat exchangers by electronic computer, together with sections on three types of power using Alco products.

Detroit Diesel Brochure

describes GM's Turbopower diesels, and includes specs along with features of design and performance data.

Speed Reducers

are discussed in the "Speed Reducer Engineering Manual" available from Westinghouse. The manual presents complete installation information on all types of speed reducers.

"Industrial Friction Materials"

is the subject of an illustrated 16-pp booklet issued by J-M. It covers asbestos brake linings, blocks, and clutch facings, and includes a chart for easy reference to design data.

NEW! Oakite SATUROL

... perfect for cleaning small diesel parts

Here's a brand new cold immersion cleaner that's just about perfect for reconditioning valves, pistons, filters, gears and other small diesel parts. It's Oakite Saturol.

What is it?

Oakite Saturol is a skillful blend of solvents for removing carbon, grease, paint, gasket compound and other tough soils. It has a high flash-point, is safe on metals. Comes ready to use, with a vapor seal floating on the solvent to inhibit evaporation — and give real economy.

How is it used?

Oakite Saturol comes in a special 6-gallon pail, complete with immersion basket. Immerse parts to be cleaned for ten minutes to half an hour, depending on type of soil. Lift out basket and rinse off parts with water or kerosene. It couldn't be easier. For large parts or volume cleaning of small parts, use tank-immersion method.

Call your local Oakite Technical Service Representative for a demonstration, or write to Oakite Products, Inc., 22C Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

What Do You Know!

(*Answers to Questions on Page 60*)

1. Correct answer is "c". Higher output engines, torque converters and shifting without power interruption all help climbing. Limitation on downhill speeds are service brake capacities. See article on Page 44.

2. Correct answer is "a". Blocking the exhaust manifold turns the engine's exhaust stroke into a compression stroke slowing up engine and vehicle. See Page 44.

3. Correct answer is "a". A major cause of abrasive wear is hard abrasive particles imbedding in face of softer cast iron rings. See Page 53.

4. Correct answer is "b". Roughly one third of total fuel input in Btu's goes into exhaust gas, a third to power and a third to cooling water. See Page 56.

5. Correct answer is "b". Very critical small restriction is multiplied in exhaust manifold, interferes with scavenging and puts high thermal load on engine parts. See article on Page 56.

6. Correct answer is "a". There's very small oil flow through turbo. Increased heat input into oil from extra power produced may require added oil cooling capacity in some cases. See Page 56.

7. Correct answer is "b". Matched converter-engine combination will not stall. See Page 63.

REBORE CONNECTING RODS IN YOUR OWN SHOP

New GREENLEE

HYDRO-BORER

Assures precise alignment.
Accurate to .0003" T.I.R.
Fast precision boring.

Quick, easy setups. For any size rods. A money-maker in every engine shop.

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Insist on VELLUMOID for Quality
GASKETS AND SHEET PACKING
FOR OIL, WATER AND GASOLINE
THE VELLUMOID COMPANY, WORCESTER, MASS.

BARSAD
Pat. Pending

FOR DIESEL ENGINE, BOILER AND GAS TURBINE FUELS

High temperature corrosion caused by sulfur, vanadium and sodium is a major problem to operators of diesel engines, gas turbines and high pressure boilers. BARSAD will prevent this corrosion.

For details write R. S. NORRIS & ASSOCIATES
LARCHMONT, New York

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HILCO
OIL MAINTENANCE EQUIPMENT
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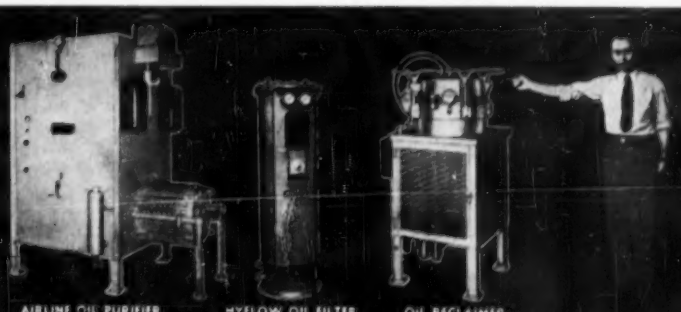


THERE'S A HILCO FOR EVERY LUBRICATING, FUEL AND INDUSTRIAL OIL PURIFYING PROBLEM
THE HILLIARD CORPORATION, 120 W. FOURTH ST., ELMIRA, N. Y.

organizational news

DEMA Elects President

Walter A. Rentschler, vice-pres. and a director of B-L-H, has been elected president of the Diesel Engine Manufacturers Association.

W. H. Rentschler

Twin Disc Announces

N. F. Adamson, VP, Sales, has announced two appointments in the General Sales Department. R. A. Harmon has been appointed Manager, District Sales; P. J. Demet has been appointed Dealer Sales Supervisor.

Hercules Executive VP

Walter L. Brough, former assistant to the president, has been promoted to Executive Vice-President of the Hercules Motors Corporation.

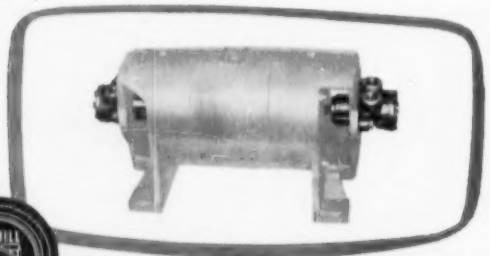
W. L. Brough

It's Just the PUMP You Want ...for FUEL TRANSFER and HYDRAULIC GOVERNOR SERVICE

TUTHILL Model L

It holds its prime. It's mechanically sealed and leak-free. It's quiet in operation. It's low in power consumption. And it's built to give years of uninterrupted service. That's why the Tuthill Model L positive displacement, internal-gear rotary pump is preferred for fuel transfer and hydraulic governor service. Capacities from .33 to 6 g.p.m. in wide pressure ranges.

Write for Catalog No. 101 for complete details.



TUTHILL PUMP COMPANY
Dependable Rotary Pumps . . . since 1927
939 East 95th Street, Chicago 19, Ill.

Canadian Affiliate: Ingersoll Machine & Tool Co., Ltd.
Ingersoll, Ontario, Canada

Synchro-Start
SPEED SENSITIVE SWITCHES

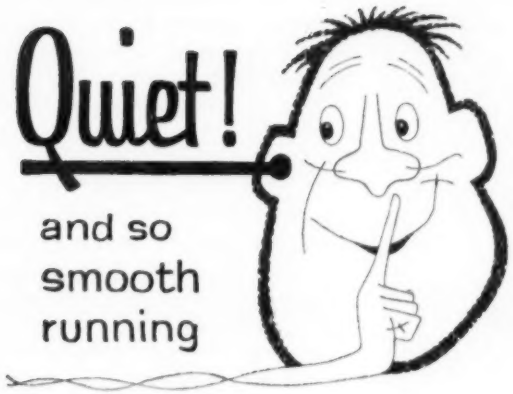
SYNCHRO-START MODEL GA-3 will open or close three independent sets of contacts at three different speeds and are suitable for installation on AND20005 aircraft tachometer drive pad. The units are adjustable while running. Standard governors can be furnished to trip points between 1,200 and 6,000 R.P.M. Speeds above or below these points must be referred to our Engineering Department for special considerations.

These speed sensitive switches are available for various types of drives.

One, two, and three switch units employ the same basic governor flyweight principle which has been used successfully in SYNCHRO-START OVERSPEED GOVERNORS during the past fifteen years.

Request Bulletin 504

SYNCHRO-START PRODUCTS, INC.
8151 N. RIDGEWAY AVE. • SKOKIE, ILLINOIS



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– the engine with the low noise level

ENTERPRISE ENGINE & MACHINERY CO.
18th and Florida Sts., San Francisco 10
Sales and Service in Principal Cities

KIENE®

MODEL K-120

universal peak firing and compression pressure indicator

The Model K-120 is the only maximum pressure indicator that can be used as a compression tester on small, high-speed engines and as a firing pressure indicator on engines having indicator valves. Patented Kiene diaphragm type check valve of stainless steel has no springs or piston, no complicated adjustments, temperature corrections or pressure loss. Bleeder valve permits release of indicator pressure for repeat readings. This instrument gives true pressure readings with an uncompensated gage.

Adaptors for most models U.S.A. engines. Others made to order at reasonable prices.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

organizational news

Minneapolis-Honeywell Plant
is to be erected at Ft. Washington, Pa. It will house the home-office and manufacturing facilities for the corporation's Valve Division.

Joining H. O. Penn
is John D. (Jack) Burley, who for several years has been a Caterpillar Field Service Application Engineer. He is with their Sales Division.

Borg-Warner Names
G. W. Kelch as president of the recently-acquired Ingersoll-Humphreys Division in Ohio. The former executive VP of the division succeeds D. J. Jones, who has been granted an indefinite leave of absence at his own request.

Allis-Chalmers Appoints
J. F. Costigan as Assistant Director of Manufacturing of Allis-Chalmers Industries Group.

Also, L. W. Long and J. H. Burrus, Jr. were appointed Assistant General Managers of Allis-Chalmers Power Equipment Div. Mr. A. I. Thorsen replaced Mr. Long.

Leece-Neville Promotion
of Edward J. Siegwarth to the post of Manager of all Plant Operations was announced by P. H. Neville, pres.

Mr. Siegwarth was formerly Superintendent of Plant #1, which manufactures fraction - horsepower motors.

Also, Homer C. Hueffed was appointed manager of Leece-Neville Industrial Engineering Dept., and James D. Barlow has been appointed Purchasing Agent for the company in Cleveland.

Garret Corporation Names
General K. B. Wolfe (Ret.) as Assistant to the Chairman of the Board, effective 17 September.

The General is widely known in aeronautical circles, and has been retired from the Air Force since 1951. Board Chairman J. C. Garrett said that General Wolfe will begin work immediately on a special, top-level assignment.

The Garrett Corporation has a reputation as a manufacturer of turbochargers.

In Memorium
Frederick A. Loeffler, director of Labor Relations at Alco since 1951, died after a short illness precipitated by a heart attack. Mr. Loeffler's passing is regretted deeply by his associates and the membership of the United Steelworkers Union, with whom he met many times at the conference table.

organizational news

Clark Names Manager

The appointment of W. T. Durkin as manager of its Pittsburgh office was announced by Clark Bros. Co., manufacturer of diesel engines, compressors, and gas turbines.

Socony Mobil Appointment

Paul A. White has been appointed Manager of the Lubricating Oil Dept. of Socony Mobil Oil Co. He succeeds P. W. Judah, named Manager of the newly-created Petroleum Chemicals Department.

Mack Announces

the appointment of Snowman W. Doe as Bus Service Manager, and Michael J. Fraino as Off-Highway Service Manager.

F-M Engineering Appointment

Fairbanks, Morse & Co. announces the appointment of R. H. Beadle to Chief Engineer, Diesel Engineering Dept., with headquarters at Beloit.

R. H. Beadle

Represents Roots-Connersville

Roots-Connersville Blower Division of Dresser Industries has appointed G. M. Wallace & Co. as Field Application Engineers for all R-C products. Offices are in Denver, Salt Lake City, and Butte.

New A-C Allentown Branch

The Mid-Atlantic Region of Allis-Chalmers announces the opening of another branch office, under the management of R. L. Haney.

MM Organizes Trading Co.

To expand the area of export operations and intensify the sale of farm machinery and industrial engines, Minneapolis Moline has organized a wholly-owned subsidiary "for the purpose of conducting a trading business in the Western Hemisphere outside the United States."

New Sharples Office

has been opened in St. Louis. It will serve Missouri, Kansas, Arkansas, southern Illinois, southern Indiana, and western Kentucky. The new office is under the direction of Howard H. Smith.

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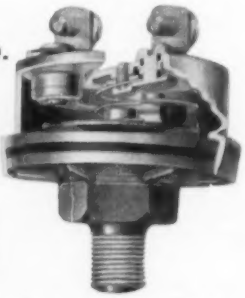

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organizational news

American M.A.R.C. Elects

Election of Benjamin Tobin, Jr. to the Board of Directors of American M.A.R.C. was announced by W. Dennis Kendall, president of the diesel engine manufacturing company. Last April, M.A.R.C. purchased the diesel division of Hallet Manufacturing Co.

Cooper-Bessemer Promotes

The promotion of J. P. Matthews to turbo charger engineer was announced by Ralph L. Boyer, vice-president and chief engineer of Cooper-Bessemer. In his new engineering capacity, Mr. Matthews will work directly under John Fullermann. Mr. Fullermann directs all engineering work on Cooper-Bessemer rotating equipment.

Nordberg Appoints

Appointment of Albert T. Metcalf as electrical engineer at Nordberg Manufacturing Company was announced by Robert E. Friend, president. He will be with the diesel engine, process, and railway divisions.

Mack District Manager

of the Syracuse, N. Y. office is J. E. Wright. He succeeds C. J. Auert, who has been appointed Special Representative.

Prior to this appointment, Mr. Wright was wholesale salesman in the Eastern Division office in N. Y.

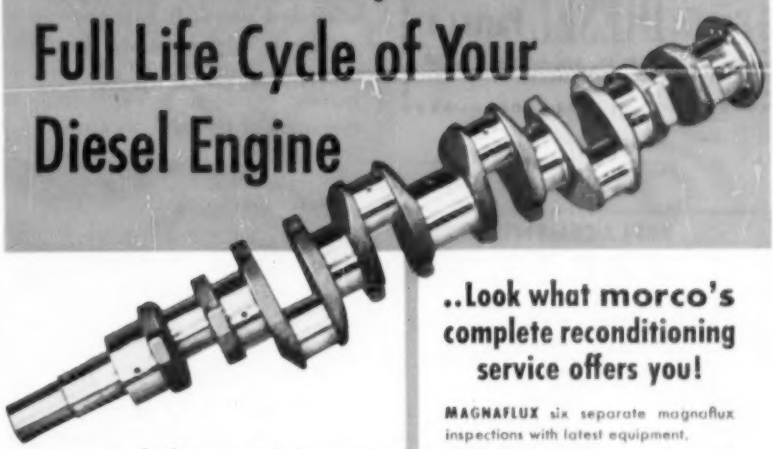
Hilco Sales Representatives

The Hilliard Corporation announces four new sales appointments: Lynn McGuffy, Houston; Ember Products, Leonia, N. J.; C. Arthur Weaver Co., Richmond, Va.; and General Equipment Co., Spokane.

Houdaille Announces

two advancements on the company's executive staff. E. M. Schugar has been made V-P in charge of government contracts; R. V. Hiraldi V-P and Group Executive in charge of Buffalo Arms, Wales-Strippit, and Buffalo Hydraulic Div. of Houdaille.

morco Factory-Certified Exchange Crankshafts give Trouble-Free Operation for the Full Life Cycle of Your Diesel Engine



morco dealers—coast to coast—are stocked with reconditioned, like-new crankshafts for different diesel engine models. Users of Detroit Diesel and Cummins engines can exchange worn shafts for MORCO factory-reconditioned shafts through authorized dealers.

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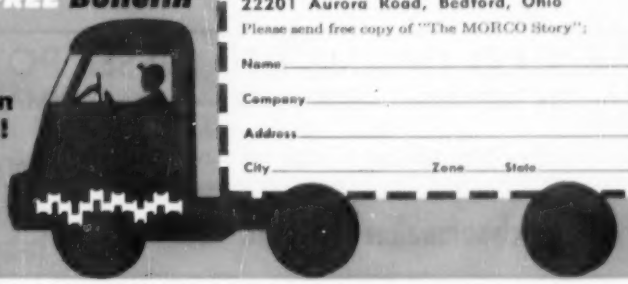

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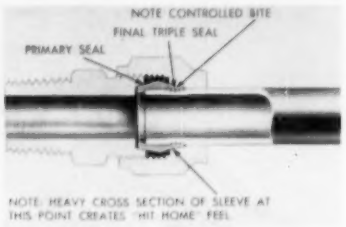
new products

Flareless Tube Fitting

Hi-Seal is a new tube fitting introduced by Imperial Brass. It is claimed to make a fool-proof, butt-tight joint designed for a full range of pressure conditions.

Available in steel or stainless steel, the fitting consists of a body, nut, and alloy-steel sleeve. It is engineered to withstand high-pressure, hydraulic surge, vibration, and other severe operating conditions. No flaring or threading of tubing is required.


NOTE CONTROLLED BITE
FINAL TRIPLE SEAL
PRIMARY SEAL
NOTE: HEAVY CROSS SECTION OF SLEEVE AT THIS POINT CREATES "HIT HOME" FEEL

Truck and Bus Air Tool

Ingersoll-Rand has developed a heavy-duty air tool designed for maintenance requiring the removal and replacement of heavy nuts and bolts.

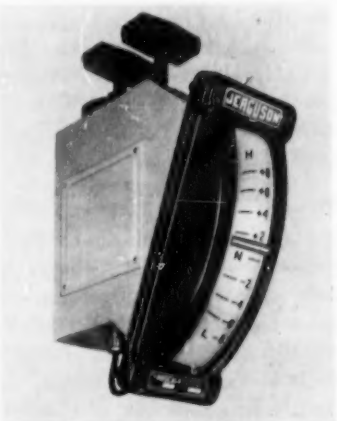
Size 334 Impactool has a side spade handle that gives the mechanic an easy-to-use tool. He can work in any position without tiring. The tool operates with a free speed of 690-rpm, delivering 1330 impacts per minute.

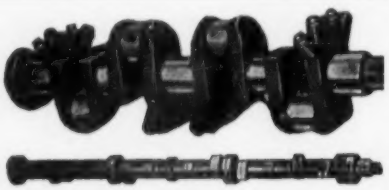
Dry Drum-Pour Sprout

Designed for use with the Sterling one-man hydraulic drum lift, this steel pouring sprout can be installed on a steel or fibre drum in a matter of seconds. The sprout features a heavy locking band that operates on the over-the-center principle. The pouring distance is extended, and the operator controls the material during the pouring operation.

Remote Reading Gage

Truscale remote-reading liquid-level gages are now available as inclined gages. They are designed for use where gages have to be mounted high, low, or at other points. Jerguson Gage & Valve Co. announced that all Truscale remote reading models are available in the inclined versions.





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new literature

"Moly-Sulfide Lube Additive"

A 12-page illustrated booklet by Climax Molybdenum Co. illustrates moly-sulfides function as a lube additive, and describes commercial uses.

Electrical Bulletins

A completely revised edition of "Electric Power Distribution for Industrial Plants" has been announced by the American Institute of Electrical Engineers. Also, "Grounding of Industrial Power systems" is available for distribution.

Precision Lapping Manual

A 28-page multi-color manual, "The Technology of Precision Lapping" is now available from Penn Scientific Products Co., illustrating and describing the use of fine diamond abrasives and the accessories required for their use in precision lapping and micro-finishing with precision-graded diamond abrasives.

Heat Exchanger Catalog

A 16-page illustrated catalog #1156 is offered by Young Radiator Co. on its new line of removeable-tube heat exchangers type-R and RW. This catalog contains all necessary design, capacity and dimension data required for complete selection and specifications of heat exchangers.

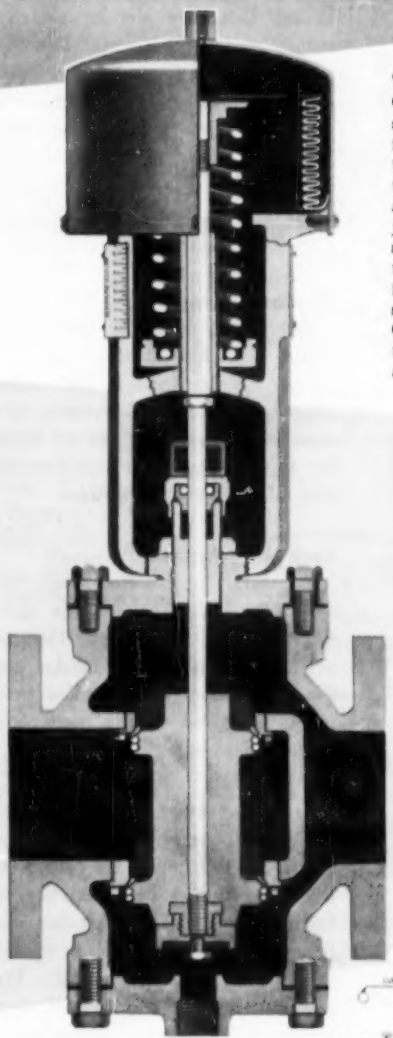
On Greases

Two water-resistant extreme-pressure greases especially recommended for shockloaded bearings are described in Sun Technical Bulletin #49, printed by Sun Oil Co.

Stud Welding Standards

A 36-page booklet on industry standards in arc-welding studs, pins, and tapped pads for stud welding has been published by K S M Products Stud Welding Div. Each specification page lists size minimums and maximums, and details mechanical properties, chemistry, thread sizes, plating and annealing information, and other data valuable to engineers, production and purchasing men.

NEW VALVE PROTECTS 3 WAYS
... STOPS GAS ENGINES QUICKLY



This new Sylphon Pressure-Operated Valve now makes possible faster, all-round protection for gas engines. Team it up with the Sylphon No. 530 Safety Control, and you can stop worrying about low lube pressure, high jacket water temperature, or overspeed. If any one exceeds the limit, this valve tightly seals off the fuel supply and vents the fuel system for immediate shut-down. On top of that, it is so versatile that you can plug the vent port and use it for many other services.

Special Sylphon® seamless bellows assures continuous valve operation. No seams to break and leak. In addition, it's made in two plies . . . easily withstands control air pressures up to 40 psi.

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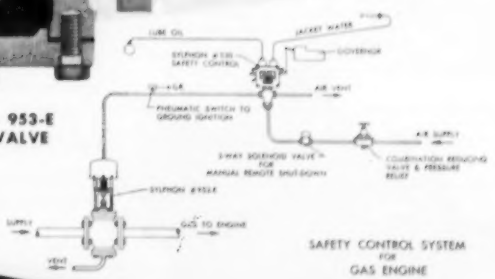

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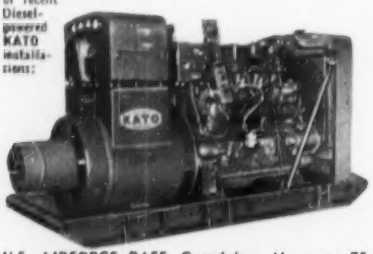
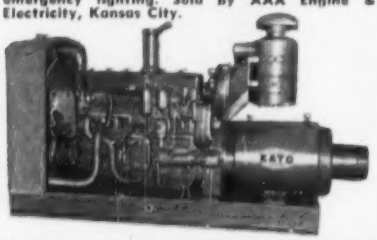
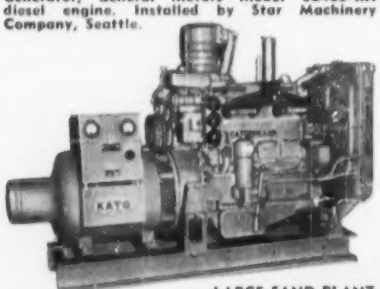


U.S. AIRFORCE BASE, Grandview, Mo. uses 75-KW, 93.8 KVA, 120/240V., 60 cycle, single phase, 1800 RPM KATO Generator, driven by P & H Harnischfeger Model 487-18 diesel engine, for emergency lighting. Sold by AAA Engine & Electricity, Kansas City.



BOEING AIRPLANE CO., Seattle, Wash., purchased 175 KW, 219 KVA, 3 phase, 3 wire, 60 cycle, 1800 RPM, revolving field type KATO Generator, General Motors Model 62403-RA diesel engine. Installed by Star Machinery Company, Seattle.



LARGE SAND PLANT, operated by Barton Const. Co., uses Model 85EPS4, 150 KW, 187 KVA, 220/440V., 3 phase, 60 cycle, 1800 RPM, 2 bearing, close coupled type KATO Generator adapted to No. 0 bell-housing on Caterpillar D337 diesel engine. Sold by Wm. H. Ziegler Co., Minneapolis.

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new products

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Shearcut Tool Co. has a push broach that may also be used as a rotary broach. As it is a standardized item, purchasers may take advantage of the savings accruing from production. Orders can be filled from stock, in size ranges from ⅛-in. to 1-in.

Duplex Tubing

Bridgeport Brass is offering bi-metal tubing, matching one alloy against inside corrosion and another alloy against outside corrosion. More than a hundred variations are available to lick any particular combination of corrosive conditions.

Fork Attachment

Log and lumber forks are now available as attachments for #977 Caterpillar Traxcavators. Designed originally as a log and lumber tool, the attachment also handles poles, pipe, palletized loads, and other similar material.

V-Belt Fastener Applicator

A tool for applying Alligator vee-felt fasteners to open-end belting has been announced by Flexible Steel Lacing Co. The pocket-size vee-fastener tool enables the user to make up belts to any length quickly. They can also keep a few feet of repair belting on hand for quick repair. This keeps machinery going until it can be repaired conveniently. The holder is made for B and C-section vee-belting.

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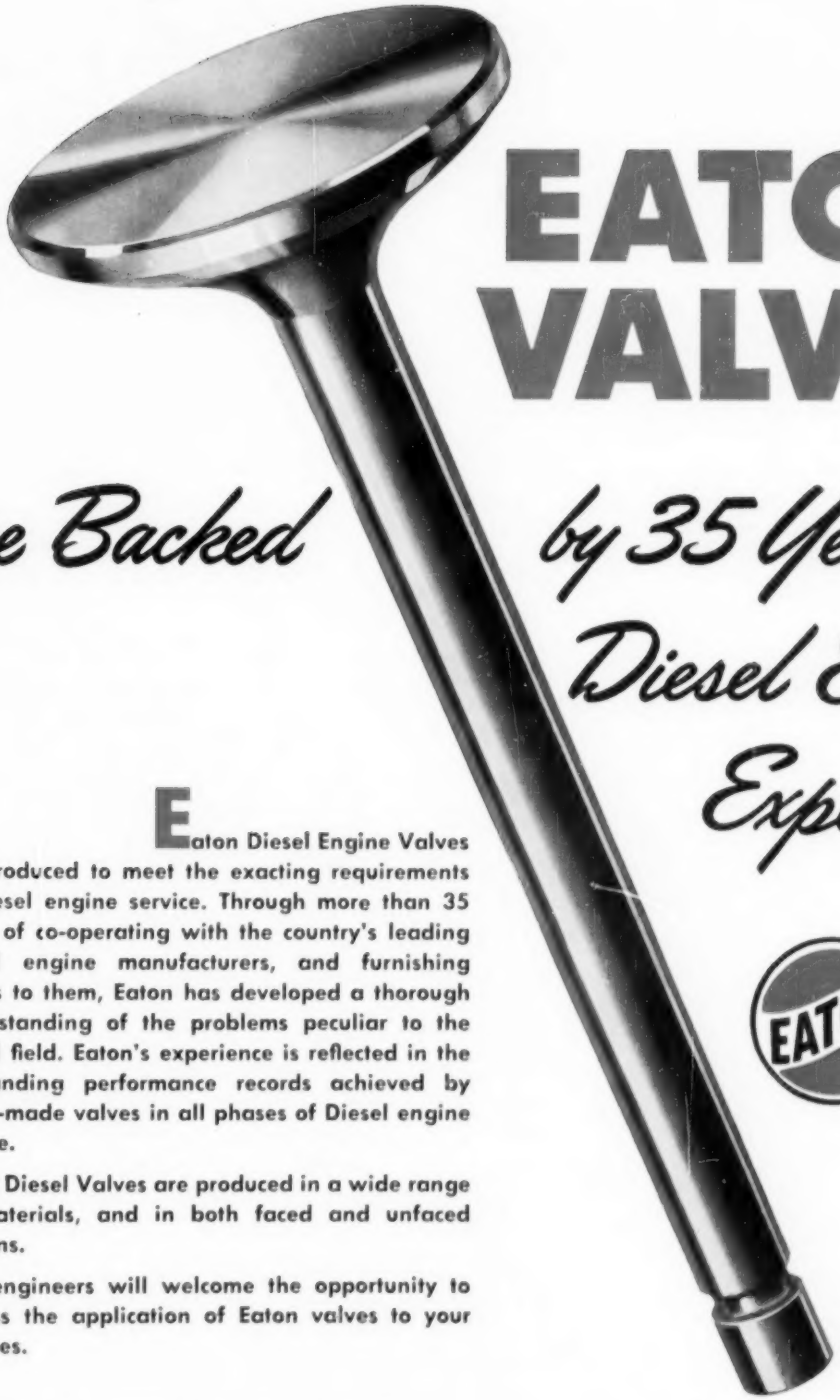

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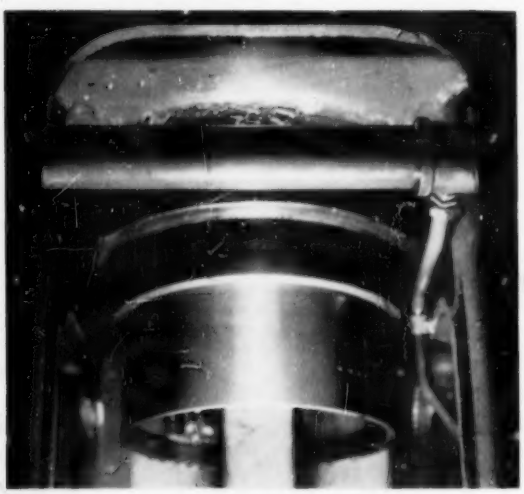
(l. to r.) Carl Olbertz, Milford plant superintendent, "Rollie" C. Bleimehl, Standard Oil industrial lubrication specialist and Frank Morgan, Milford chief engineer inspect crankcase. Rollie Bleimehl is qualified to give technical service on jobs like this. He's been doing this sort of work for 10 years. Rollie has a mechanical engineering degree from Iowa State College and has completed the Standard Oil Sales Engineering School.

23,000 hours on original rings and bearings—no overhaul

Milford, Iowa, Light Plant gets this performance from engine using STANODIESEL Oil M



"As is" photo of piston skirt and interior of crankcase. No wiping or cleaning was done before photographing or at any time during 23,232 hours engine has been in service. STANODIESEL Oil M is the lubricant.

When a new 720 H.P. Superior engine was put in service at Milford, Iowa in 1949, the plant management knew what oil they were going to use—STANODIESEL Oil M. Their choice was based on previous experience with Standard diesel oils in other engines.

After 23,232 hours of operation, the engine at Milford is still operating with the original bearings and rings. It has not been overhauled. The crankcase, as shown in the photo, is clean. Pistons are clean and bright with no sign of wear. Twice yearly, oil samples have been taken for laboratory analysis. Each time the analysis has shown the oil to be in perfect condition. Good maintenance and STANODIESEL Oil M have contributed to this performance.

Got a hard job for an oil? STANODIESEL Oil M can do it. STANODIESEL Oil M has superior stability. Its additive formula helps to (1) prevent oil viscosity build-up (2) keep crankcase, pistons, cylinder walls and other parts clean (3) control foam (4) maintain film on difficult to lubricate areas and parts.

There's a Standard Oil industrial lubrication specialist near you in any of the 15 Midwest or Rocky Mountain States. Call him for more information about STANODIESEL Oil M. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate areas and parts.
- Eliminates spark plug fouling in spark ignited engines and reduces combustion chamber ash deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil commingle.

STANDARD OIL COMPANY
(Indiana)

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